Clean Air Strategy for Alberta

BACKGROUND PROJECT REPORTS:

A Definition of Clean Air

Full Cost Accounting

Market-Based Approaches to Managing Air Emission in Alberta

Natural Gas & Electric Utility Incentives

Energy Efficiency Legislation in Alberta and other Jurisdictions

Inventory of Transportation Initiatives

Coordination of Science and Technology Relevant to Clean Air Issues

Energy and Environmental Education Initiatives

Background reports prepared for the Clean Air Strategy for Alberta.
June 1991

Clean Air Strategy for Alberta

A DEFINITION OF CLEAN AIR

Prepared by:
Clean Air Definition Development Group

For:
Clean Air Strategy Advisory Committee

May 1991

93-01217/

A DEFINITION OF CLEAN AIR

TABLE OF CONTENTS

	Page
Summary	ii
Introduction	1
Toward A Definition of Clean Air	3
A Definition of Clean Air	5
Air Quality Indicators	5
Knowledge Gaps	6
• Air Chemistry and Processes	6
• Effects on Health, Ecosystems and Property	7
• Integration of Issues and Information	8
• Technology and Management Practices	8
Concluding Remarks	9
Appendix	10

SUMMARY

The Clean Air Definition Development Group defines "clean air" as **air that is odourless, tasteless, looks clear and has no measurable short-or long-term adverse effects on people, animals and the environment. Clean air is a goal to be sought by reducing emissions from human activity to achieve a healthy atmosphere and a sustainable environment.**

By this it is meant that "clean air" at any particular time is the attainment of air quality such that the atmosphere in urban or rural settings is odourless except for natural aromas, tasteless and free of visible man-caused haze, and has no constituent or accumulation of constituents sufficient to cause measurable short-or long-term adverse effects on human health, the ecosystem or the global atmosphere. Over time, the application of this definition will be influenced by new information and perception such that the attainment process will become progressively more stringent. The purest degree of clean air is acknowledged to be an atmosphere that approximates the presumed composition of undisturbed air in the natural environment and in which excursions in the chemical composition of that are not much greater than those resulting from natural atmospheric processes. Natural disasters such as forest fires are beyond the control of man and are viewed as exceptional cases.

This definition of clean air requires the absence of measurable short-and long-term adverse effects on people, animals and the environment. An integrated overall air quality and environmental index should consider such indicators as: (1) aesthetic quality, including odour, taste and visibility; (2) human health status related to wellness, respiratory illness, radiation impacts and demographic trends; (3) ecosystem health status related to vegetation, soils, water, and animals; (4) materials damage; (5) measurements of the ambient chemical quality of the air (including pollutants) locally and regionally and in the background air entering the province; and (6) mass input/output trends such as output indicated by emissions inventories, and production and consumption of sulphur and carbon.

The knowledge gaps on clean air are grouped under the following headings: (1) characterization of the air chemistry and the processes by which this chemistry is produced; (2) effects on health, ecosystems and property of the various chemical constituents in isolation and in combination (mixtures); (3) the integration of environmental issues and information to obtain a better assessment of the status and consequences of changing air quality; and (4) technology and management practices for reducing emissions and improving air quality.

It is important to note that the definition of clean air that has been developed has not been restricted to energy-related emissions nor has it excluded air toxins. At a later date the Strategy that is developed to manage air quality in Alberta must be broadened to include emissions that arise from non-energy-related activities and air toxins. Progress toward the goal of clean air must be monitored and assessed as new information and technology becomes available.

INTRODUCTION

The Clean Air Strategy for Alberta is a joint initiative of Alberta Energy and Alberta Environment intended to encourage public discussions on air emissions resulting from the production and use of energy in Alberta. The objective of the Strategy is to help identify and clarify the most important issues associated with energy production and uses that need to be addressed in developing the Strategy, and to outline practical and achievable actions that can be taken by consumers and producers to reduce emissions. The process is guided by a 15-member Advisory Committee composed of representatives from environmental groups, local government, public health authorities, the native community, the energy, transportation, chemical and utilities industries, and provincial government departments. An Issues and Options Workshop, held in September 1990, was the first phase of the Strategy development. The main purpose of this workshop was to examine key questions on the need for and the scope of actions to deal with greenhouse gas emissions, acid deposition and smog. One of the major questions identified at this workshop was "what is 'clean air' and how do we know when we achieve it?". Accordingly, the Advisory Committee recommended the establishment of a working group called the Clean Air Definition Development Group (members listed in the Appendix) with the following terms of reference:

1. to develop a definition of "clean air" that addresses global, national, provincial and regional concerns over effects of ambient air quality on ecosystems and human health;

2. to identify indicators of "clean air" that can be used in the development of the Strategy; and

3. to identify the knowledge gaps in our understanding of emissions and issues within the mandate of the Strategy;

It is hoped that the "clean air" definition which is finally accepted will provide the vision and foundation for an operating definition that will guide the establishment of ambient air quality objectives for regulatory purposes which result in the protection and enhancement of air quality in Alberta for generations to come.

The major difficulty in coming up with a workable definition of clean air is that the word *clean* is a relative term. The word means different things to different people. Dictionaries define clean as free from dirt, soil, impurity or defilement as well as unblemished or pure. But it is its connotations (in addition to its explicit literal meaning) that gives it ambiguity. For instance, one of the strongest implications of the word is the absence of contaminants, chemical or biological, that could affect health.

What is usually meant by the public by clean air is the chemical quality of the air before massive input of the wastes from human activity into the atmosphere. Atmospheric chemists have used the terms "pristine" and/or "background" air quality to describe this condition. Both

terms implicitly allow for variations in air quality caused by natural processes including forest fires, volcanoes, etc. As well, background air quality means different things to different people, depending on their experience and where they have lived.

For simplicity in regulatory applications, air quality objectives have been formulated for individual chemicals somewhat in isolation from the total physical and chemical characteristics of the atmosphere. Ideally, the regulatory view and the physical and chemical characteristics of the atmosphere should now be blended together, but to do this one must deal with ranges of concentrations rather than single objectives or targets. However, it must be recognized that our understanding of the atmosphere is poor and our facts limited. For instance, the controversy about global atmospheric change stems from the lack of chemical knowledge and understanding about the atmosphere and the consequences of changes in chemical composition.

The chemical quality of the air in any region is determined by what is transported into the region, by what is produced in that region and by the interaction of this combination with the climate of that region. The term "regional air quality" is used to describe the chemical state or condition of the atmosphere in a defined area. This is also a relative term because a regional atmospheric concentration is an average concentration for a region which is commonly made up of a series of atmospheric measurements which may vary in time (seasonal or annual) or space (northern Alberta or southern Alberta). It is clear, therefore, that the regional background concentration of an atmospheric component will vary within a range of values.

What air quality is required to maintain and improve human, animal and environmental health? How do we reach this goal? To answer these questions points of reference must be defined for the status of the chemistry of the atmosphere for all regions. This range of values must reflect air influenced by natural environmental processes and chemical components transported into the province. If economic development is to continue in Alberta without adverse environmental impact, there must be a long-term commitment to managing the chemistry of the atmosphere.

At this time, the effects of air pollution on human health are not fully understood. These health effects are difficult to identify and document and are often subtle in their mode of action. Recent evidence suggests that significant health effects can be observed at ambient concentrations that now occur in Canada and that may occur in Alberta. Regardless of the magnitude of the observed effects on health, it seems certain that human well-being, enjoyment of life, quality of existence, and thus health, interpreted as a positive state of wellness (well-being), are all reduced in some measure by the perception and knowledge that air is not clean. From the standpoint of a definition, clean air is more than just air that does not result in medical illness but air that is perceived as healthful, non-threatening, and does not detract from the enjoyment of life.

Likewise, the effect of air pollution on the integrity of the environment is also more subtle than the documentation of overt damage to the ecosystem suggests.

The issues related to air quality are complicated but because of their interrelationships often lend themselves to common solutions by controlling emissions at their source. Alberta supplies the fossil fuels that result in emissions in other provinces and outside Canada. In producing this energy, Alberta makes a significant contribution of Canada's energy-related gaseous emissions. Canada, in turn, produces a small percentage of the world's total emissions, but it represents a high emission rate per capita because of its cold climate and its energy intensive industries. Canadian initiatives to reduce emissions will have major implications in Alberta unless these emissions are placed in a more global perspective.

The material presented in the sections that follow is a summary of the deliberations of the Clean Air Definition Development Group.

TOWARD A DEFINITION OF "CLEAN AIR"

Air pollution is a problem that exists on many levels. At least six distinct issues are now recognized and are listed as follows:

1. air pollution, most obviously in the form of smog, as it affects urban, isolated industrial, rural, and wilderness (by transport of air masses) areas;

2. emissions of chemical substances in a local area from "point" sources;

3. acidic deposition and the long-range transport of air pollution;

4. global ecological changes, potentially possible due to climate change and alteration of the stratospheric ozone layer, that result from large scale emissions from numerous sources in many countries;

5. air toxins released to the environment and their effects, especially on humans and animals; and

6. indoor air quality in residences, workplaces, and public buildings. (This issue is not being addressed by the Clean Air Strategy because ambient air quality is only one of many factors involved in problems with indoor environments.)

Although each of these issues is distinct, there are many interrelationships. Local point-source emissions contribute to ambient air quality further downwind and can be involved in acid deposition and can contribute to the total global emissions of the "greenhouse" and other gases. Indoor air quality is partly determined by outdoor ambient air quality.

The Clean Air Definition Development Group met on four occasions: November 13 and December 6, 1990 and January 10 and February 1, 1991. Representatives in the Group reflect both public and private sector viewpoints. The Group began with discussions of definitions of "clean air", air quality indicators, and knowledge gaps proposed by individual members.

Following these initial discussions, small working groups generated draft "clean air" definitions as well as potential indicators of changing air quality and a list of knowledge gaps. These suggestions provided the basis for Group deliberations and the ultimate synthesis of a consensus "clean air" definition and lists of air quality indicators and knowledge gaps. Review comments from the Advisory Committee were taken into consideration in the revised report of the Group.

The definitions of "clean air" offered by committee members tended to reiterate certain themes. These included:

1. a need for perceived cleanliness, including the aspects of visibility, taste and odour;

2. absence of adverse effects to health;

3. absence of adverse effects to the ecosystem;

4. a comparison to a natural state (only man-made emissions considered);

5. a need to separate the definition from specific air quality objectives;

6. compatibility with the concept of "sustainable development"; and

7. zero-discharge is ideal but unachievable from a practical standpoint.

Although not included as an integral part of a general definition, several participants used the exercise to put forward a number of concerns that may apply to the translation of definitions into operating standards:

1. the operating definition of clean air is necessarily based on standards and regulations and these should be guided in theory by the more general definition;

2. economic aspects be taken into consideration;

3. there is a need to take into consideration the possibility of unpredictable or interactive effects from exposure to more than one chemical at the same time;

4. potential effects must be taken into consideration but *measurable* negative effects should be emphasized in establishing the rationale for standards and guideline; and

5. "clean air" is not a specific characteristic but is an objective, suggesting that the achievement of acceptable air quality is " a moving target". The corollary to this is that objectives (standards) may be developed and subjected to regular review as new evidence and technology become available.

A DEFINITION OF CLEAN AIR

The Group's considerations lead to a proposed consensus definition which is:

"Clean air" is air that is odourless, tasteless, looks clear and has no measurable short-or long-term adverse effects on people, animals, and the environment. Clean air is a goal to be sought by reducing emissions from human activity to achieve a healthy atmosphere and a sustainable environment.

By this it is meant that "clean air" at any particular time is the attainment of air quality such that the atmosphere in urban or rural settings is odourless except for natural aromas, tasteless and free of visible man-caused haze, and has no constituent or accumulation of contaminants sufficient to cause measurable short-or long-term adverse effect on human health, the ecosystem or the global atmosphere. Over time, the application of this definition may be influenced by new information and perceptions such that the attainment process may become progressively more stringent. The purest degree of clean air is acknowledged to be an atmosphere that approximates the presumed composition of undisturbed air in the natural environment and in which excursions in chemical composition are not much greater than those resulting from natural atmospheric processes. Natural disasters such as forest fires are beyond the control of man and are viewed as exceptional cases.

The concept of clean air as an on-going process is an essential part of the definition because it anticipates future scientific evidence, public perceptions and preferences, and technological capabilities that do not now exist. Although the implementation of the definition at a given time may depend on economic feasibility, there must be constant review of the progress made toward clean air. Otherwise, the perception will persist that air quality is not as clean as it could be and that environmental values are compromised. A commitment to regular review and steady improvement challenges society to do its best within a framework of economic reality and provides industry with a predictable direction for its business plans.

AIR QUALITY INDICATORS

The definition of clean air requires the absence of adverse effects. This implies the need to measure short-and long-term effects and trends in air quality. The indicators adopted for this purpose should reflect the definition and also be feasible. An integrated overall air quality and environmental index should consider such indicators as:

1. aesthetic quality, including odour, taste and visibility;

2. human health status related to wellness, respiratory illness (e.g. asthma), radiation impacts (e.g. cataracts, melanoma), and demographic trends (e.g. self-selection);

3. ecosystem health status related to vegetation (e.g. lichen injury, leaf chlorosis), soils (e.g. acidification, nutrient leaching), water (e.g. chemistry changes with acidification), and animals (e.g. wildlife population trends, domestic animal health);

4. material damage (e.g. erosion, corrosion and soiling);

5. measurements of the ambient chemical quality of the air (including pollutants) both locally and of background air entering the province; and

6. mass input/output trends such as output indicated by emissions inventories, and the production and consumption of sulphur and carbon.

Considerable research and development must yet be done to learn how to use these indicators as reliable and informative measures of air quality. For example, at the present state of knowledge, human health status indicators are not sufficiently developed to serve in isolation as indicators of clean air. Human health outcomes become less sensitive as air quality improves and they are affected by many other factors.

KNOWLEDGE GAPS

The definition of clean air and the suggested indicators of air quality imply that we need to know how air smells, tastes and looks, what effect ambient air has on people and the environment and how emissions into the atmosphere from human activity can be reduced.

The knowledge gaps can be grouped under the following headings:

1. characterization of the air chemistry and the processes by which this chemistry is produced;

2. effects on health, ecosystems and property of the various chemical constituents separately and in combination (mixtures);

3. the integration of environmental issues and information to obtain a better assessment of the status and consequences of changing air quality; and

4. technology and management practices for reducing emissions and improving air quality.

Air Chemistry and Processes

The Alberta Government/Industry Acid Deposition Research Program (ADRP), which was partly directed at characterizing the chemistry of the atmosphere in Alberta, showed that regional air quality in Alberta is highly variable and that point source and urban air quality monitoring alone is not adequate to protect the atmosphere in Alberta. The strict regulatory/compliance view of air quality, which focuses on concentrations of specific atmospheric contaminants exceeding prescribed levels, should be broadened. As well, a global perspective to changing air quality should be adopted. The following is a summary of identified gaps in knowledge and/or our understanding with respect to air chemistry and the processes that determine it. There is a need for the following:

1. to characterize and quantify the air quality chemistry and atmospheric chemical processes of the different regions in Alberta. These data will help set the terms of reference or range of atmospheric constituent concentrations in the different regions;

2. to characterize and quantify the contribution of natural environmental processes to the atmosphere both with respect to sources and sinks of pollutants and the interaction between climate and air chemistry;

3. for a comprehensive and ongoing emissions inventory for all natural and human activity sources in Alberta;

4. to re-evaluate the relevance of air quality monitoring which focuses on point sources in the light of new concerns and changing priorities;

5. to utilize a rigorous quality assurance/quality control protocol in any air quality monitoring/research to ensure information and data of high quality and low uncertainty.

Effects on Health, Ecosystems and Property

Air respects no boundaries and the pollutants carried in the air eventually affect all of us. As far as some members of the public are concerned, the primary focus of the Clean Air Strategy for Alberta is to answer the questions " How does the quality of air affect my health and what has to change in the areas of energy production and use that will lead to improved human health" (as stated in one written submission). Although the direct link between ambient air quality and negative impacts on health appears to be weak at the present time, some members of the public believe that increased industrial emissions lead to a sick environment which will eventually lead to sick people. In view of this, there is a need to:

1) identify substances that may be a factor in environmental and human health including substances from non-energy related emissions and air toxins;

2) identify more consistent and easily measurable short-and long-term adverse effects on human and animal health and physiological adaptation resulting from changes in ambient air quality and to correlate these with levels of exposure (both in magnitude and time) and thresholds of effect;

3) identify potential adverse effects on ecosystems from changes in ambient air quality, and to correlate these changes with levels of pollution or thresholds of effect;

4) develop and apply a series of environmental indicators that are representative and indicative of human and environmental health and which are understandable; and

5) identify the most sensitive environmental indicators that can be monitored for the purpose of assessing air quality; and
6) ensure that the public is well informed.

Integration of Issues and Information

The environment is composed of many intimately related components which are in a constant state of flux. In the past, a fragmented approach to understanding these components and their dynamic changes over time and space has been used which has only been partially successful. An integrated approach is now required. Such an approach will result in masses of data, all of different type, that will need to be integrated in some sensible fashion into an understandable overall assessment of air quality and its environmental and human and animal health impacts. One way to approach this integration problem is to build models, both conceptual and numerical. Thus, there is a need to:

1) develop techniques for addressing environmental issues in an integrated, proactive manner;

2) re-evaluate the data and information already available in the context of an integrated approach;

3) develop and maintain comprehensive and readily accessible (to both the public and private sector) data and information bases; and

4) develop and test conceptual and numerical models which can be used not only as tools to assess current atmospheric conditions, environmental health status, and human and animal health status but also to predict future enhancement or degradation of air quality and its impacts on the environment and on human and animal health.

Technology and Management Practices

Since the definition of clean air that has been presented states that "clean air is a goal to be sought by reducing emissions from human activity to achieve a healthy atmosphere and sustainable environment" one must know how emissions can be reduced. Furthermore, the Clean Air Definition Development Group expressed a strong commitment to the consideration of the economic viability of technology implemented to reduce emissions and the need for a reasonable cost/benefit ratio associated with technological improvements. Thus, there is a need to:

1) assess available new technology for reducing emissions both with respect to effectiveness and cost;

2) develop new technologies for reducing emissions;

3) develop and assess management strategy options for reducing emissions through emission caps, economic instruments, etc.; and

4) develop integrated scientific and integrated environmental management approaches to air quality and other environmental issues, including adaptation strategies.

The above may not be an exhaustive list of knowledge gaps.

CONCLUDING REMARKS

The definition of clean air, the indicators and the list of knowledge gaps that have been developed do not refer specifically to energy-related emissions nor do they exclude potential problems caused by air toxins. At some point, the strategy that is developed to manage air quality in Alberta must be broadened to include emissions that arise from non-energy-related activities and air toxins. Progress toward the goal of clean air must be monitored and assessed as new information and technology become available.

APPENDIX
CLEAN AIR STRATEGY FOR ALBERTA
CLEAN AIR DEFINITION DEVELOPMENT COMMITTEE MEMBERS

CO-CHAIRMAN
Dr. T. L. Guidotti
Professor of Occupational Medicine
Department of Health Services
Administration and Community Medicine
Faculty of Medicine
13 - 103 Clinical Sciences Building
University of Alberta
Edmonton, Alberta T6G 2G3
(403) 492-6291
(403) 492-0364 Fax

CO-CHAIRMAN
Dr. A. H. Legge
Environment Research & Engineering Dept.
Alberta Research Council
3rd Floor, Digital Building
6815 - 8 Street N. E.
Calgary, Alberta T2E 7H7
(403) 297-7525
(403) 275-3003 Fax

SECRETARY
Dr. Marianne English
Science Advisor
Environmental Affairs Branch
Alberta Energy
7th Floor, North Petroleum Plaza
9945 - 108 Street
Edmonton, Alberta T5K 2G6
(403) 427-5200
(403) 427-2278 Fax

Mr. R. P. Angle
Standards and Approvals Division
Alberta Environment
4th Floor, Oxbridge Place
9820 - 106 Street
Edmonton, Alberta T5K 2J6
(403) 427-5872
(403) 422-4192

Dr. Nicholas J. Bayliss
Medical Officer of Health
Leduc-Strathcona Health Unit
2011 Brentwood Blvd.
Sherwood Park, Alberta T8A 0X2
(403) 467-5571
(403) 449-1338 Fax

Mr. P. D. Bruchet
Canadian Petroleum Association
3800 Petro Canada Building
150 - 6 Avenue S. W.
Calgary, Alberta T2P 3Y7
(403) 269-6721
(403) 261-4622 Fax

Mr. I. Burn
Executive director
Energy Efficiency & Environmental Affairs
Alberta Energy
7th Floor, North Petroleum Plaza
9945 - 108 Street
Edmonton, Alberta T5K 2G6
(403) 427-5200
(403) 427-2278 Fax

Mr. S. L. Dobko
Environmental Assessment Division
Alberta Environment
5th Floor, Oxbridge Place
9820 - 106 Street
Edmonton, Alberta T5K 2J6
(403) 427-6102
(403) 422-9714 Fax

Mr. G. Flynn
Director, Environmental Health Services
Alberta Health
Seventh Street Plaza
10030 - 107 Street
Edmonton, Alberta T5J 3E4
(403) 427-2643
(403)7 422-0914 Fax

Mr. T. Goos
Chief, Scientific Services
Atmospheric Environment Service
2nd Floor, Room 240
4999 - 98 Avenue
Edmonton, Alberta T6B 3X3
(403) 495-3143
(403) 468-7953 Fax

Mr. J. F. Kostler
Manager, Environmental Affairs
Alberta Power Ltd.
10035 - 105 Street
Edmonton, Alberta T5J 2V6
(403) 441-3429
(403) 420-5410 Fax

Mr. J. C. Lack
Director
Standards and Approvals Division
Alberta Environment
4th Floor, Oxbridge Place
9820 - 106 Street
Edmonton, Alberta T5K 2J6
(403) 427-5883
(403) 422-4192 Fax

Mr. J. W. Lilley
Environment Council of Alberta
8th Floor, Weber Centre
5555 Calgary Trail, Southbound
Edmonton, Alberta T6H 5P9
(403) 427-5792
(403) 427-0388 Fax

Mr. R. H. Mitchell
Environmental Affairs Branch
Alberta Energy
7th Floor North Petroleum Plaza
9945 - 108 Street
Edmonton, Alberta T5K 2G6
(403) 427-9793
(403) 427-2278 Fax

Dr. K. Nickerson
Syncrude Canada Ltd.
P.O. Box 4009 MD 1060
Fort McMurray, Alberta T9H 3L1
(403) 790-4250
(403) 790-4334 Fax

CO-ORDINATOR
Dr. H. Sandhu
Corporate & Strategic Management
Alberta Environment
3rd Floor, Oxbridge Place
9820 - 106 Street
Edmonton, Alberta T5K 2J6
(403) 427-0047
(403) 422-5136 Fax

Clean Air Strategy for Alberta

FULL COST ACCOUNTING

Prepared by:
Alberta Department of Energy
Environmental Affairs Branch

June 1991

TABLE OF CONTENTS

Page

1. Introduction ii

2. Full Cost Accounting 1

    What is Full Cost Accounting? 1

    Why Full Cost Accounting? 1

3. The Challenges of Full Cost Accounting 2

    Identification and Valuation of All Costs and Benefits 2

    Validation 3

4. Experience with Full Cost Accounting 3

    Voluntary Action 4

    Command and Control Approaches 4

    Market-Based Approaches 4

5. Conclusion 6

6. Suggested Reading 7

7. Appendix A -- Comparison of Decision Aiding Techniques 8

8. Appendix B -- Internalizing External Costs in Utility Rates 9

9. Authors and Resource People 10

INTRODUCTION

In March of 1990 the Government of Alberta initiated the Clean Air Strategy for Alberta, a process designed to encourage public discussion on air emissions resulting from the production and use of energy. The objectives of the Strategy are to help identify and clarify the most important issues associated with the production and use of energy, and to outline practical and achievable actions that can be taken by producers and consumers to reduce emissions. The process is guided by a 15 member Advisory Group which comprises representatives from government and non-government entities. The process is jointly managed by Alberta Energy and Alberta Environment.

As part of the consultative process, an Issues and Options Workshop was held in Edmonton in September 1990. The purpose of the workshop was to identify the issues, options, uncertainties, information needs and implications for both short and long term actions in developing a Clean Air Strategy for Alberta.

During the workshop, participants were in general agreement that energy production and use should cause the least possible impact on the environment as well as make economic sense. "Full cost accounting" was identified as one possible method to analyze the overall costs and benefits of energy production and use. As a result, a recommendation was made to review and briefly summarize the concept of full cost accounting.

Therefore, it is the intent of this paper to:

1) define full cost accounting;

2) examine why full cost accounting might be attempted;

3) discuss the main challenges to full cost accounting;

4) review some instruments that encompass aspects of full cost accounting; and

5) illustrate the theoretical attractiveness of full cost accounting.

FULL COST ACCOUNTING

What is Full Cost Accounting?

Full cost accounting is the explicit recognition of all costs and benefits of a transaction, whether they are incurred by the direct beneficiaries of that transaction or any third parties. Full cost accounting, for the purpose of the Clean Air Strategy, is the attempt to identify and place a value on "external costs and benefits" so they may be incorporated with "internal costs and benefits" into an economic assessment of an energy transaction.

Internal costs are those that are the responsibility of the direct beneficiaries of a transaction. Internal costs normally include the cost of equipment, materials or services. Since the direct beneficiaries of a transaction are responsible for internal costs they have a vested interest in minimizing these costs. **Internal benefits** are those that accrue to the direct beneficiaries of a transaction, such as profit or achievement of a specific objective.

External costs are those that the direct beneficiaries to a transaction do not bear. External costs include any negative impact on the ecosystem[1] such as environmental degradation or negative health effects. Consequently, direct beneficiaries generally have no incentive to reduce the external costs of their transactions. **External benefits** are those that accrue to the ecosystem as a result of a transaction.[2]

INTERNAL VS EXTERNAL COSTS AND BENEFITS
An Example:

When someone drives to work they consider their **internal costs** (fuel, maintenance and depreciation) and **internal benefits** (convenience). They do not normally consider the **external costs** (the effect of the car's emissions on public health and the environment, or the additional delay the presence of the car imposes on others) or the **external benefits** (all economic and social spin-offs resulting from the operation and maintenance of the car).[2]

Why Full Cost Accounting?

The production and use of energy invariably involves the use of "public" resources. Public resources are those that either everybody owns or nobody in particular owns (e.g., air). Economic principles suggest that because there is a lack of ownership (property rights) or markets (lacking or impaired), public resources will be overused and inefficiently allocated among competing users. Therefore, in theory, the establishment of property rights and functioning markets for previously "free" resources would ensure the most efficient use of those resources.

Full cost accounting goes beyond establishing property rights and markets for degrading or depleting public resources (external costs) in that it attempts to include external benefits in economic assessments. By assessing all the costs and benefits of transactions, full cost

---

[1] Ecosystem: the system formed by the interaction of all living things of a particular environment with one another and with their habitat.

[2] Many economists contend that external benefits tend to be local or regional in nature, and that on a global basis no external benefits result from energy transactions.

accounting can be used as a planning and decision-making tool in evaluating the impact of existing and future energy transactions on the ecosystem. Future energy transactions include potential energy supplies and alternative technologies to develop resources. For example, suppose a power plant was required in a certain area and coal, natural gas and wind power were the identified fuel alternatives. The process of full cost accounting would identify and attach values to all internal and external costs and benefits associated with each supply option and the various technologies available to produce electricity. The decision could then be based upon economic and social factors.[3] The attraction is that the evaluation of economic and social factors would be completed in one common unit, that being dollars.

Full cost accounting can also be used to assess and evaluate existing energy transactions. The purpose of subjecting existing transactions to full cost accounting is to again assess whether costs or benefits are being imposed on the ecosystem. If external costs are being imposed, the actual dollar value of the impact determined through full cost accounting would assist in deciding upon the solution for mitigation or elimination, or the parties responsible for the external costs could be required to internalize them.

THE CHALLENGES OF FULL COST ACCOUNTING

Identification and Valuation of All Costs and Benefits

To develop an operational system of full cost accounting, all costs and benefits associated with transactions need to be identified and valued. Since the internal costs and benefits of transactions are accounted for by the parties involved, only external costs and benefits remain to be identified and valued. There are numerous uncertainties and potential limitations to identifying and valuing external costs and benefits of transactions. Some of the challenges in the identification and valuation of external costs include the following:

1) How much impact must an external cost have on the ecosystem before action should be taken to mitigate or eliminate the cost? This is a scientific question in which a cause-and-effect relationship must be established between an external cost and a negative impact on the ecosystem. Scientists often agree that a cause-and-effect relationship exists (e.g., air pollution causes respiratory distress), but may disagree on the magnitude of the relationship (e.g., the concentration and length of exposure to pollution that is necessary to bring on an asthma attack). In some cases a relatively strong relationship may exist, such as the impact of acid deposition on buildings. In other cases, the relationship is not as developed and the effect may be delayed, as in the case of global warming. Therefore, questions arise as to the level in which full cost accounting should be taken, and whether all parties causing external costs on the ecosystem should be held equally responsible. For example, a gas compression facility releases one thousand cubic feet per day of methane into the atmosphere. Should a farmer who has comparable methane emissions from cattle be held equally responsible?

2) External costs are difficult to attach values to because society may disagree on the associated value (e.g., how much is one tonne of sulphur dioxide emissions worth?). Attaching a value to an external cost is essentially placing a value on human life and the

[3] Economic and social factors: economic refers to material wealth or the dollar value of costs and benefits; social refers to the lifestyle of human beings and includes environmental costs and benefits.

ecosystem. Some people argue that no dollar value can compensate for degrading or destroying any part of the ecosystem. The difficulty is not only determining the present value of one tonne of sulphur dioxide emissions, but what is the future cost to recover, repair or restore the ecosystem to a state of equilibrium if an amount of sulphur dioxide is emitted?

3) It is difficult to attach responsibility to external costs. In some cases, responsibility is straight forward, in others, several emission sources may contribute over time (or in combination with natural sources) to produce significant external costs, as may be the case in global warming.

External benefits are also difficult to identify and value because, in theory, it can be argued that energy transactions ultimately result in the degradation or depletion of resources and no benefits accrue to the ecosystem. However, since mankind has developed a certain standard of living, external benefits can be classified as those that enhance a region's standard of living.

There is a whole range of external benefits resulting from energy transactions that improve the standard of living within a region. For example, a new plant or factory provides spin-off economic activity (i.e., additional economic activity to serve the new plant, and businesses to serve those, and so on -- the multiplier effect). Even though these benefits tend to be restricted to the region where the plant locates, there are also external benefits to other regions (e.g., federal and provincial income taxes paid by the plant can be used to fund projects/programs in other domestic or even foreign regions).

The preceding challenges to developing an operational system of full cost accounting are by no means all encompassing because there are costs and benefits peculiar to each individual transaction. The common difficulty in identifying and placing a value on all external costs and benefits is the subjectivity of both identifying the level to which full cost accounting should be taken and the valuation of external costs and benefits.

Validation

Validity and reliability are concerns with all models and studies, especially those with numerous decision points, as in the case of full cost accounting. To validate full cost accounting, two questions need to be addressed: 1) have all the important external costs and benefits been identified?; and 2) have the correct values been attached to the external costs and benefits?

At the present time, there appears to be no "certain" way to answer these questions. One way to test the validity and reliability of full cost accounting as a decision-making tool would be to establish a baseline measure of the ecosystem and then compare that level to the same measure at a future date. If this ecosystem measurement moves within a predicted range over a period of time, a degree of confidence can be established in full cost accounting.

EXPERIENCE WITH FULL COST ACCOUNTING

In theory, no "actual" full cost accounting is occurring. In practice, however, there have been numerous attempts to include external costs and benefits into economic assessments of energy transactions. Decision-making techniques that lean toward full cost accounting are the conventional benefit-cost analysis, environmental impact assessments, socio-economic impact

assessments or even quasi-judicial reviews (e.g., an Energy Resources Conservation Board project review). The difference between full cost accounting and these methods is that full cost accounting attempts to identify and attach dollar values to all costs and benefits; whereas, the other methods may or may not attach values to external costs and benefits, and they often omit significant external costs and benefits. For a description and list of the advantages and disadvantages of several techniques that aid in decision-making, see Appendix A.

The aforementioned methods focus on decision-making, however, there are numerous other instruments that are aimed at the operational side of full cost accounting. These methods are designed to require compensation from parties for their external costs, or require parties to internalize external costs. Three broad approaches have been identified that achieve this: voluntary action, command and control approaches, and market-based approaches. In isolation, voluntary action lies at the opposite end of a continuum from command and control approaches, while market-based approaches encompass aspects of both.

Voluntary Action

At one end of the continuum, society takes voluntary actions through changes in attitudes by exhibiting preferences for more environmentally friendly products and services, and the voluntary internalization of external costs. This is the least intrusive method of having external costs internalized since no regulatory measures are required. However, voluntary internalization occurs in only a minority of cases because there is generally little or no incentive for parties to voluntarily internalize external costs. A good example of public pressure to spur parties to consider external costs voluntarily was the organized boycott of McDonalds to change their packaging.

Command and Control Approaches

At the other end of the continuum, command and control regulatory measures can be enacted by governments through direct regulations and mandatory standards to force parties to compensate for, or to internalize external costs. At their most intrusive, command and control measures specify the amount of discharge permitted and mandate the technology to be used to meet the permitted discharge. Command and control approaches generally include laws, standards and regulations. A generic definition may be: specific rules or regulations passed by lawmaking bodies which govern actions or procedures, that may or may not be enforced by the courts. To be effective, command and control measures usually require enforcement measures.

Market-Based Approaches

Somewhere between these two extremes are market-based approaches, which contain elements of both extremes. Some examples are given below:

1) Taxes, Charges, Licence and User Fees -- These instruments are used to recover all or part of external costs through price increases. These price increases can be arbitrarily set or calculated estimates of external costs. In either case, price increases attempt to reflect external costs by equating the mitigation or elimination cost with the external cost (e.g., a tax is set at a level where it is an incentive for the party to reduce the external cost), or by having the party responsible compensate for the external cost (e.g., pay to pollute). To work effectively and equitably, taxes, charges, licence and user fees

must be set at different levels in different areas (i.e., the more an environment is polluted, the higher the external cost of an additional unit of pollution is likely to be). Not only do they need to be adjusted periodically to reflect the pollution of the day, but also the dollars of the day.

2) Subsidies\Credits -- Subsidies are the opposite of taxes (sometimes referred to as "tax expenditures"), and provide incentives in a variety of ways: to assist parties in reducing the use of environmentally sensitive inputs or detrimental discharges; to renew resource bases where there is no longer sufficient market incentive; and to share in the risk of developing products and processes that reduce external costs. A concern with subsidies is that they are incompatible with the principle of "polluter pay", as they often fund external costs (e.g., subsidization of automobile natural gas conversions).

3) Tradeable permits -- Tradeable permits involve establishing an emission cap within an area and assigning property rights to unused levels of discharge. These unused levels are then traded in the market. Tradeable permits allow parties to decide whether to adjust their technology to meet the allocated discharge target or purchase discharge permits from other firms. Purchasing permits is favored by those parties facing higher discharge reduction costs than the going rate for discharge permits. Conversely, parties that can efficiently reduce their discharge costs will find it profitable to reduce emissions and sell excess discharge permit credits. In order to function effectively tradeable permits must be understood and accepted by all those involved; there must be a ceiling discharge level set for the area in which they are designed; and a functioning market must evolve with the trading of permits. If trading is not allowed or does not occur due to market imperfection, a tradeable permit system is little more than a command and control system. Conversely, if the ceiling is set above the level required by industry, then a tradeable permit system becomes a voluntary system.

4) Legal liability/legal agreements -- Although legal liability is often not established until after the fact, possible legal liability is often an incentive for parties to internalize external costs. Legal agreements can also cause a party to internalize a formerly external cost by specifying the type of action that must be performed by one party (e.g., an oil sands plant signs a land reclamation agreement).

There are numerous instances of the use of voluntary, command and control, market-based approaches and techniques that aid in decision-making. All encompass aspects of full cost accounting. There are also numerous other efforts being made to further the development of full cost accounting. For example, the U.S. Department of Energy has commissioned studies at the Oak Ridge National Laboratory and Resources for the Future to analyze all of the external costs of different methods of energy production. The studies, which are scheduled to be completed in 1992, will attempt to measure fossil, uranium and renewable resource impacts, including the effects on air and water quality.

Developing an inventory of methods encompassing aspects of full cost accounting and who is using them is beyond the scope of this paper. Nevertheless, in an attempt to provide an idea of the scope of the approaches being considered and used, a survey is summarized in Appendix B on activities by U.S Public Utility Commissions in their regulation of utilities to include external costs in their planning and ratemaking.

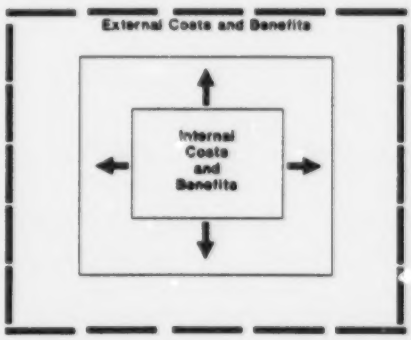
CONCLUSION

There are numerous reasons why full cost accounting should or should not be adopted. In theory, full cost accounting is attractive from two perspectives. First, it is conceptually simple: identify and place a value on all costs and benefits of a transaction so they can be incorporated into an economic assessment of the transaction's impact on the ecosystem. Second, full cost accounting appeals to society's basic sense of justice in that those causing external costs are held accountable for their actions (i.e., polluter pay).

Despite the theoretical attractiveness of full cost accounting, many challenges still remain. One major challenge is identifying, valuing and attaching responsibility to all external costs and benefits of a transaction. Another major challenge is to design and implement a system that will create a "level playing field" for everyone. This entails having all sectors, of all industries, of all regions, adopt the same accounting rules. Otherwise, economic distortions might occur and those who adopt full cost accounting could be put at a competitive disadvantage relative to those who do not adopt full cost accounting.

Undoubtedly, some of the difficulties associated with full cost accounting will never be overcome. However, the challenges that full cost accounting presents should not be viewed as reasons to entirely reject moving toward a system of full cost accounting. As the following diagram illustrates, the inability to identify all the costs and benefits of a transaction should not be an impediment to identifying at least some of the costs and benefits.

The outer broken line represents all external costs and benefits associated with a transaction, to which there is some uncertainty. The internal costs and benefits box represents those costs and benefits that are currently considered in the assessment of a transaction. The larger box enclosing the internal costs and benefits box represents how moving toward a system of full cost accounting will include more external costs and benefits into assessments. Therefore, even though all external costs and benefits are not included, a system of full cost accounting has the potential to provide a structured approach to evaluate transactions. In theory, over time, this will lead to more responsible transactions.



SUGGESTED READING

Alberta Environment. 1990. "Economic Instruments and Environmental Protection -- A Discussion Paper". December.

Cohen, S.D., J.H. Eto, C.A. Goldman, J. Beldock and G. Crandall. 1990. A Survey of State PUC Activities to Incorporate Environmental Externalities into Electric Utility Planning and Regulation. National Association of Regulatory Utility Commissioners.

Doern, G.B. (ed). 1990 The Environmental Imperative: Marketing Approaches to the Greening of Canada. Renouf Publishing, Ottawa.

Harrison, D. Jr. and A.L. Nichols. 1990. "Benefits of the 1989 Air Quality Management Plan For the South Coast Air Basin: A Reassessment". National Economic Research Associates (NERA). March.

Hohmeyer, O. 1988. Social Costs of Energy Consumption: Effects of Electricity Generation in the Federal Republic of Germany. Springer-Verlag, Berlin.

Hubbard, H.M. 1991. "The Real Costs of Energy". Scientific America. April. Volume 264, Number 4.

Hull, B. and A. St-Pierre. 1990. The Market and the Environment: Using Market-Based Approaches to Achieve Environmental Goals. The Conference Board of Canada.

Ottinger, R. L. (etal). 1990. Environmental Costs of Electricity, New York: Oceana Publications, New York.

Pearce, D. and A. Markandya. 1989. Environmental Policy Benefits: Monetary Valuation, Organisation for Economic Co-operation and Development (OECD).

Repetto, R. 1990. Promoting Environmentally Sound Economic Progress: What the North Can Do. World Resources Institute, Washington, D.C.

APPENDIX A

COMPARISON OF DECISION-AIDING TECHNIQUES

TECHNIQUE	DESCRIPTION	ADVANTAGES	DISADVANTAGES
1. Benefit-cost analysis	Evaluates policies based on a quantification of net benefits (benefits - costs) associated with them.	Considers the value (in terms of what individuals will pay) and costs of actions: translates outcomes into commensurate terms: consistent with judging by efficiency implications.	No direct consideration of distribution of benefits and costs; significant information requirements; tends to omit outputs whose effects cannot be quantified; tends to lead to maintenance of status quo; contingent on existing distribution of income and wealth.
2. Cost effectiveness analysis	Selects policy that will minimize costs of realizing the policy goal or objectives.	No need to know the benefits; focus is on information often more readily available; provides implicit values of the objective (e.g., marginal cost of increasing by one unit).	No consideration given to relative importance of outputs; degree to which all costs considered will be important to judgements as to "best" approach; how to treat social costs resulting from side effects.
3. Multiple criteria analysis	Uses mathematical programming techniques to select projects based on objective functions, including weighted goals of decision maker, with explicit consideration of constraints to action and costs.	Offers consistent basis for making all project or regulatory decisions; fully reflects goals and constraints incorporated in model; allows quantification of implicit costs of constraints; permits prioritizing of projects.	Results only as good as inputs to model; unrealistic characterization of decision process; must supply the weight to be assigned to goals; large information needs for quantification.
4. Risk-benefit analysis	Evaluates benefits associated with a policy in comparison with its risks.	Framework is left vague for flexibility; intended to permit consideration of all risks, benefits and costs; not an automatic decision rule.	Too vague; factors considered to be commensurate are not.
5. Decision analysis	Step-by-step analysis consequences of choices under uncertainty.	Allows various objectives to be used: makes choices explicit. Explicit recognition of uncertainty.	Objectives not always clear; no clear mechanism for assigning weights.
6. Environmental impact assessment and socio-economic impact assessment.	Detailed statements of an action's impacts, adverse effects, alternatives; requires a balancing of economic and social benefits and costs.	Explicitly requires consideration of social effects; ability to place a monetary value does not pre-empt numeration of all benefits and costs of an action.	Difficult to integrate descriptive analyses of intangible effects with monetary benefits and costs; no clear criteria for using information in decision.

Source: Environmental Policy Benefits: Monetary Valuation, Organization for Economic Co-operation and Development, 1989, P. 21.

APPENDIX B

INTERNALIZING EXTERNAL COSTS IN UTILITY RATES

Electricity producers and regulators are now more than ever aware of the environmental consequences of electricity production. In the U.S., some state Public Utility Commissions (PUC) formally require external costs to be considered in their regulation of utilities.

A May 1990 survey of U.S. state PUCs reported that 17 PUCs (out of 49 surveyed) had adopted explicit rules to incorporate external costs into the resource planning and/or acquisition process (Note: the survey was a "snapshot" of activities at one point in time in a rapidly evolving environment). The approaches taken by the PUCs affected utility regulation in two general areas: ratemaking, and resource planning and acquisition processes.

In the context of ratemaking, several PUCs adopted approaches that implicitly incorporate external costs into the ratemaking process by permitting higher rates of return for resource alternatives that have lower external costs. External costs identified in ratemaking are paid by the consumer.

Conversely, external cost considerations in resource planning and acquisition processes are never paid by anyone as they are used as a decision-making tool. The three basic methods of accounting for external costs used by states in resource planning and acquisition processes included:

1) qualitative treatment of external costs. This method allows for non-financial factors to be considered in the evaluation of a project (e.g., the state of Nevada passed regulations that allow the PUC to "give preference to the measures...that provide the greatest economic and environmental benefits to the state");

2) use of a percentage adder/subtractor that is applied to the capital cost of resources during the planning process. This method arbitrarily increases the cost of resources that have "significant" external costs, and decreases the cost of resources with lower external costs (e.g., in Wisconsin utility companies are required to credit non-combustion technologies, which means non-fossil supply technologies and demand-side resources can cost 15% more than a combustion source and still be considered comparable in terms of overall societal costs); and

3) direct quantification of external costs as part of resource planning and/or acquisition processes. This approach, which is increasingly being adopted, attempts to estimate the monetary value of external costs. The dollar value estimate is then given a weight and added to the cost of the resource. (e.g., in Oregon utilities are required to give a range of expected values for external costs of resource options).

It should be noted that the approaches outlined above are not mutually exclusive. In fact, some states used more than one method or combination of methods. (e.g., Connecticut allows a higher rate of return for some utility investments and also requires utilities to evaluate external costs qualitatively in their resource plans).

AUTHORS

Calvin Karabonik
Alberta Energy

Bob Mitchell
Alberta Energy

Dennis Wong
Alberta Energy

RESOURCE PEOPLE

Mark Anielski
Alberta Forestry

Paul Booth
Alberta Treasury

Guy Bridgeman
Alberta Energy

Jason Edworthy
Small Power Producers Association

Murray Ellis
Alberta Environment

Fred Homeniuk
Energy Resources Conservation Board

Les Johnston
Electrical Utilities Planning Commission

Gord Lambert
Canadian Petroleum Association

Nick Nichols
National Economic Research Associates

Jim Swiss
Canadian Petroleum Association

Clean Air Strategy for Alberta

MARKET-BASED APPROACHES TO MANAGING AIR EMISSIONS IN ALBERTA

Prepared by:
National Economic Research Associates, Inc.

For:
CPA
Alberta Energy
Alberta Environment

May 1991

This is the executive summary of a report prepared by National Economic Research Associates, Inc. Copies of the full report are available from the CASA office by calling 427-9793.

Alberta is considering a wide range of options for dealing with air-quality issues. In 1990, the Government of Alberta initiated a public consultation process called the "Clean Air Strategy for Alberta". That process is designed to spur broad discussion of Alberta's air-quality issues, to help define the most pressing problems and to decide how best to control them (Alberta Government 1990). As part of that process, the Clean Air Strategy is exploring opportunities for using market-based approaches in managing emissions more effectively and at lower cost. This paper has been developed to help inform those discussions. It focuses on two particular types of market-based approaches: tradable emission permits and emission charges or taxes.

We begin with the concepts and prior experience, and then apply the lessons to two air-related issues in Alberta:

- acid deposition related to emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_x); and
- global warming and emissions of carbon dioxide (CO_2).

The study of acid deposition develops and evaluates a market-based approach to controlling SO_2 (and possibly NO_x) emissions that Alberta could adopt and implement fairly quickly. In the case of CO_2, however, the debate about targets and means of achieving them is at an earlier stage. Perhaps even more importantly, the global nature of the issue makes it critical that Canada act in concert with other nations.

Thus, the analysis of market-based approaches for CO_2 is intended to provide some background information relevant to those larger debates, rather than to design a specific policy instrument that Alberta might adopt.

A. Concepts Behind Market-Based Approaches

The basic concept behind market-based approaches is simple. The government sets overall goals for emissions, but allows market forces to determine the most cost-effective way of achieving those goals. With emission trading, the government sets the total emissions allowed, but then allows firms to "trade" emission allocations. As the result of such trades, emission reductions occur where they cost the least, so that overall societal costs are reduced relative to conventional uniform emission standards that achieve the same environmental goals. Emission charges or taxes work in a similar way. By setting a price on emissions, they provide an incentive for sources to reduce emissions, but do not specify how much specific sources should control, as do conventional emission standards.

1. How Trading Reduces Costs

Emission standards impose high costs for two reason. First, the standards for different source categories typically are based upon the "availability" and "affordability" of control technologies, which creates wide variations among different source categories in the marginal cost of emission control. Second, uniform standards for the sources within a single category (e.g., sour gas sulphur extraction plants) lead to very different costs per tonne controlled; the same SO_2 standard may cost relatively

little per tonne for a large plant with a long remaining life and a sulphur-rich input stream, but much more for a smaller plant that will soon close.

With trading, high-cost sources can buy emission permits from low-cost sources. Buyers and sellers both gain from the flexibility afforded by trading. Buyers (high-cost firms) gain because they can buy the additional permits for less than they save in control costs. Sellers (low-cost firms) gain because they receive more than it costs them to undertake the additional controls. Consumers and the country as a whole gain because these transactions lead to lower overall costs of pollution control, without relaxing the level of environmental protection.

2. Auctions and Taxes

The government may choose to auction permits rather than distribute them to existing sources. With auctions, the overall savings to society remain the same, but the distributional effects are likely to be quite different. Auctions impose significantly higher costs on sources, because they must pay for the permits as well as the control devices. Depending on the market structure, however, the higher costs often will be passed on to consumers in the form of higher prices for the goods whose production creates emissions. In some cases, these higher prices can provide important incentives for consumers to reduce their purchases of such goods.

Emission charges or taxes work in a way similar to tradable permits. Like tradable permits, charges or taxes cause sources to reduce emissions by raising the cost of polluting. The charge or tax rate plays the same role as does the permit price. The primary difference is that in a tradable permit system, the government sets overall emissions by setting the total number of tradable permits available; with an emission

charge or tax it sets the price that sources must pay to emit, but leaves the overall emission level to be determined by market forces.

B. Experience with Emission Trading and Taxes

In concept, emission trading and emission taxes can yield substantial savings in control costs compared to emission standards. Actual experience, however, has been mixed. The largest trading program has suffered from a cumbersome, uncertain and expensive review process, while most "green taxes" have been designed more to raise revenue than to provide appropriate incentives for sources to reduce emissions. Nonetheless, there are important positive examples as well. Both types of experience—the negative as well as the positive—provide useful information for designing effective programs.

1. U.S. Experience with Trading

The actual experience with emission trading—which is limited thus far to the U.S.—includes both clear successes and programs whose performance has fallen well short of their promise. An example of the latter is the set of four "emission trading" (ET) programs developed by the U.S. Environmental Protection Agency (EPA) in the late-1970s, to add flexibility to the existing air pollution control program. (The most widely known of these trading programs is the "bubble" policy; the other three are offsets, netting, and banking.) Virtually every commentator gives the program a mixed review. Total cost savings almost certainly amount to less than 1 percent of air pollution control costs, reflecting the small number of actual trades that have taken place. The major problem seems to be that trading has been very tightly controlled—

the regulations take up 47 fine-print pages—and firms have been concerned that any gains they achieve might be confiscated later through tightened standards or other means.

In contrast, trading for lead in gasoline is widely regarded as a success. In 1982, EPA set a more stringent limit on the amount of lead per gallon but allowed a refiner to produce lead above the limit if it purchased a sufficient number of permits from refineries that produced gasoline with lead below the limit. A provision allowing "banking" for refiners that reduced lead in advance of requirements was introduced in 1985 when the limit was reduced still farther. The combination of the trading and banking provisions generated substantial savings for refiners (and their customers). Moreover, the ability to trade and bank lead appeared to have allowed a faster phase-down of lead, largely because the stringency of the lead standard was not limited by the technical capabilities of certain small refiners.

Programs similar to the lead trading program have been designed for the control of chlorofluorocarbons (CFCs) and acid rain pollutants. The CFC program shows how a scheme can be designed to limit emissions of pollutants from many dispersive uses (e.g., hair spray) by controlling the production and import of the raw ingredients. The limits on production and imports drives up the price of CFC's and leads to a market determination of which uses will decline and by how much. The acid rain program (just passed as part of the new Clean Air Act) shows how a program to control emissions from power plants and other stationary sources can be designed. Both programs appear likely to generate large cost savings; estimated savings

are about 25 percent for the acid rain program and up to 50 percent for the CFC program.

2. Experience with Taxes and Charges

Taxes or charges with at least a nominal relationship to environmental concerns have become increasingly common in many countries, particularly in Europe, and their use is likely to grow. For example, the Task Force on the Environment and the Internal Market created by the Commission of the European Communities has recommended that the community give priority to developing market mechanisms in member countries. However, virtually none of the existing charge schemes is structured to provide incentives to reduce pollution as outlined above.

Most of the charge schemes that are now in place are in fact modest taxes on polluting products that are designed to raise revenues—typically to cover the cost of public treatment or other public expenditures—rather than to provide incentives to reduce pollution and to minimize compliance costs. A German charge scheme for water effluents in place since the mid 1970s offers the major exception to this general rule, though even it serves as a supplement to effluent standards, rather than as a replacement.

3. Implications for Designing Market-Based Approaches in Canada

Perhaps the most important lesson from the U.S. experience with trading is that adding trading after an existing set of standards is in place is unlikely to be fully successful. The ET program became mired in red tape and concerns about "equivalent" trades. In contrast, the lead trading program was adopted when new limits were set, and it was completely integrated into the system. The CFC program

and the acid rain trading programs also are integral parts of their respective regulatory programs.

The primary lesson from the experience thus far with charges and taxes is that if they are to be used to manage emissions effectively—rather than primarily to raise revenues—they must be carefully designed and applied to appropriate targets. More specifically, to provide incentives to reduce pollution (and minimize control costs) a charge or tax should have two characteristics:

- the charge must be based upon the amount of pollution produced (or a close proxy), so that the charge to a firm will be reduced if it generates less pollution; and
- the *charge rate* must be large enough to affect firms' decision-making; small pollution charge rates will simply raise revenue rather than reduce pollution, particularly if they are imposed in concert with a tight standard.

C. Acid Deposition

"Acid rain" has been a major issue in Canada and the U.S. for more than a decade. The primary concern has been that acidic particles formed in the atmosphere from emissions of sulphur dioxide (SO_2) and (to a lesser extent) nitrogen oxides (NO_x) damage lakes and forests. Since 1988, provinces in eastern Canada have been subject to negotiated limits on emissions of SO_2 and NO_x. In the U.S., the new Clean Air Act includes provisions to reduce SO_2 emissions from electric generating stations by roughly 50 percent, and to reduce NO_x emissions by a smaller amount.

At the November 1990 meeting of the Canadian Council of Ministers of the Environment (CCME), the provinces and the federal government agreed to extend the

eastern cap on SO_2 to western Canada. A specific limit—not to exceed 3.2 million tonnes nationwide in the year 2000—will be set after further discussion, as will specific provincial limits. The Clean Air Strategy and other ongoing deliberations within Alberta also will affect the specific limit set by the province.

Because the goal for SO_2 is almost certain to be stated as a cap on total emissions, emission trading is a particularly attractive option. With trading, the province could fix the overall quantity of emissions, assuring that the targets set would be reached. In contrast, if the province were to use an emission charge, the level of emissions would depend on how sources responded. Even with emission standards, the province would not be assured of reaching the target, because standards typically set rates for individual sources; the total emitted depends on the number of sources, their levels of capacity utilization, and other factors beyond the direct control of the province.

1. Design of a Trading Plan

If a trading plan is to assure achievement of environmental goals while allowing trading to proceed freely to minimize costs, responsibilities need to be specified clearly. The basic structure of the plan that we propose may be summarized as follows:

- The program would apply to larger stationary sources of SO_2; the precise criteria for inclusion would have to be specified by the province, but the number of sources involved probably would be 250 or less.
- The province would set an overall emission target for sources included in the plan, reflecting the CCME commitment and other factors.

- The province would allocate the emission target among existing sources, based on historical data (e.g., production levels).

- Sources would be allowed to trade their allotments of emissions and to save unused allotments for future use.

- Sources would be required to monitor emissions and to report all trading transactions, but preapproval of trades would *not* be required.

- To guard against local "hot spots," sources would continue to be subject to the ambient standard for SO_2; trading would replace only the emission standards per se (e.g., percent removal requirements for sour gas plants).

- The province *might* decide to limit trading within some subprovincial regions, to protect particularly sensitive ecosystems or to prevent excessive increases in emissions in certain areas. Alternatively, it might consider broader trading regions that include other western provinces.

2. Likely Performance of the SO_2 Trading Plan

The primary motivation for using market-based approaches generally is to lower the overall costs of meeting environmental goals. Unfortunately, the source-specific control-cost data needed to estimate the cost savings in Alberta are not available. Numerous other studies, however, have estimated savings of 20 percent or more in similar situations. For example, a recent NERA study for Ontario Hydro found that it could save 17 to 31 percent of the costs of meeting NO_x reduction targets if it were simply allowed to trade within its own network of generating plants in southern Ontario. Because the gains from trading are based primarily on *differences* in control costs among sources, these figures understate the likely savings from a broader trading scheme involving a more heterogeneous group of sources. Emission trading also is likely to lower costs by opening up additional methods of emission

reduction (e.g., replacing older plants with newer ones) and by providing greater flexibility for the development and introduction of new control techniques

Emission trading could achieve the same emission-reduction goals as standards, but would provide substantially greater certainty that the goals would be achieved. Emission standards and nontradable operating permits set limits for individual plants, but do *not* provide provincial regulators with a method by which to explicitly manage total emissions; the overall goal may be violated, for example, if industrial activity grows, or older plants are not retired as quickly as expected. In contrast, emission trading fixes the total. Emission trading also may allow faster achievement of environmental goals, because the flexibility offered by trading means that the pace can be based on the capabilities of the average firm; firms that cannot meet the schedule can buy coupons from firms that can go faster.[1] With standards, in contrast, if the government tightens the rules faster than some firms can adjust, it runs the risk of forcing those firms out of business, with attendant economic disruption and visible unemployment.

The overall burden placed on government is likely to change little in moving from standards to trading, but its nature may be different. Emission trading should *reduce* the government's cost of developing rules, because it does not require developing a detailed understanding of the control technologies associated with each source category, as is necessary if reasonable standards are to be set. The resources needed for monitoring emissions and enforcing compliance with trading should be

[1]The regulator must still be careful, however, not to set so fast a pace that the slower firms are not balanced by firms that can exceed the overall pace.

similar to those needed with standards. On the other hand, administrative costs will *increase* somewhat as the result of the need to operate the trading system and to track holdings. However, these expenses should not be great, and could be covered by a small administrative fee.

3. Extending the System to NO_x

The trading system could be extended to cover NO_x emissions, the other major precursor of acid deposition. Reductions in NO_x also may be based on concerns about ground-level ozone, although Alberta's ozone problems are minimal.

Developing a similar program for NO_x would be straightforward. NO_x sources are much more numerous than those for SO_2, however, so such a program would be somewhat more difficult to administer. A NO_x plan also might be modified to take account of seasonal and locational issues related to ground-level ozone, although earlier NERA analyses of that issue for Environment Canada and for Ontario Hydro suggest that such complications probably are not necessary. If Alberta decided to extend trading to NO_x, it also should consider allowing sources to make trades between NO_x and SO_2.

4. Conclusions and Next Steps

Our analysis suggests that emission trading for SO_2 or NO_x sources in Alberta could offer considerable savings in compliance costs over conventional emission standards, without sacrificing environmental goals or imposing significantly higher demands on provincial regulators. If Alberta agrees that emission trading is promising, the logical next step would be to conduct a more detailed evaluation of legal and administrative questions related to implementation. Assuming that analysis did not

identify any major obstacles, implementation could proceed quite quickly, probably starting with SO_2, and then possibly expanding to NO_x.

D. Global Warming

In half a decade, global warming has gone from relative obscurity—a problem of interest primarily to a small group of specialists—to being the most widely discussed environmental issue in the world. Many nations have made at least nominal commitments to stabilizing or even shrinking their emissions of carbon dioxide (CO_2), the most important of the gases contributing to global warming. Canada has announced its intention to stabilize CO_2 emissions at 1990 levels by the year 2000. It seems likely that whatever strategy is adopted will involve some mix of measures to reduce overall energy use and to reduce reliance on fossil fuels, particularly coal. As the major producer of fossil fuels in Canada and one of its larger consumers as well, Alberta will be greatly affected by such policies.

Much of the current debate about global warming revolves around whether to act now to reduce emissions of CO_2 and other greenhouse gases or to wait until research narrows the enormous uncertainties that surround estimates of the effects of global warming and of the costs of reducing emissions. Our analysis is *not* addressed to those issues. Instead, we focus on analyzing how different market-based mechanisms might be used to achieve whatever targets are chosen through the political process. For purposes of our analysis, we assume that Canada has decided upon some goal for stabilizing or reducing CO_2 emissions—expressed either in terms of a quantity of emissions, or in terms of a price that the country is willing to pay to achieve reductions.

1. CO_2 Emissions and Methods of Reduction

The Intergovernmental Panel on Climate Change (IPCC) estimates that CO_2 accounts for just slightly more than half of the net annual increase in temperature forcing due to greenhouse gases. CO_2 accounts for virtually all of the discussion of potential reductions, however, because CFCs already are scheduled for phase-out, and sources of the other gases are less well understood and appear to be less susceptible to control.

Combustion of fossil fuels accounts for about four-fifths of CO_2 emissions; carbon in the fuel combines with oxygen from the air to make CO_2. Unlike traditionally regulated pollutants—such as SO_2 or NO_x—CO_2 is not amenable to add-on controls to remove it from the exhaust streams from combustion processes. Instead, reductions in CO_2 emissions will come from two basic sources:

- reducing the carbon content of the fuels used, through switching from fossil fuels to non-fossil fuels (such as nuclear, hydro, or other renewables), or from high-carbon fuels (especially coal) to lower-carbon fuels (primarily natural gas); and

- reducing overall energy use through a wide range of means, from more efficient generation of electricity and greater efficiency in end uses, to changes in consumption patterns, shifting the mix towards less energy-intensive goods.

Most studies have concluded that reduced energy use is likely to be the more important of the two general methods, but both will be required if overall costs are to be minimized. Moreover, in contrast to many pollution problems, it seems almost

certain that cost-effective strategies will require a broad array of changes, rather than reliance on any single technological approach.

Conventional standards are unlikely to prove very effective in achieving this efficient mix of actions. The most frequently discussed standards—energy efficiency standards for new vehicles and appliances—deal with only one aspect of the problem. Many of the market-based approaches that have been suggested have similar drawbacks. Allowing firms to trade within sectors to meet efficiency requirements, for example, would increase flexibility *within* sectors, but would not broaden the coverage of those rules. Broad-based energy taxes could provide strong financial incentives to reduce energy use, but would not spur a change in the energy mix toward lower-carbon fuels.

2. Carbon Trading

If the goal is to reduce CO_2 emissions, the most cost-effective incentives will be those targeted specifically on carbon, but with as broad coverage as possible of different sources of carbon emissions. One such approach would be to employ a system of tradable carbon coupons. It would be impracticable to monitor all of the different sources of carbon emissions, but the same effect could be obtained by dealing with carbon in fuel. The government would issue tradable carbon coupons each year equal to the desired level of carbon emissions. To produce or import fossil fuels, firms would be required to submit one coupon for each tonne of carbon in the fuel. Firms would be allowed to trade coupons freely, and to bank unused coupons for use in later years. In addition, the government would rebate coupons to firms that exported fuels; converted fuels to petrochemicals or other uses that did not result in carbon emissions; or "scrubbed" CO_2 from exhaust streams and placed it in long-term

storage. With the exception of credits for scrubbing—which would be exercised rarely, if at all, for the foreseeable future—the system could be administered using records that already are maintained for other purposes.

The coupon system would reduce CO_2 emissions by restricting the total amount of carbon in fuel. As a result of the restriction, the coupons would develop a price. That price then would be reflected in the prices of imported and domestically produced fossil fuels, with larger effects for fuels higher in carbon. Higher prices for those fuels in turn would provide incentives for firms and consumers to switch to energy sources with less carbon (e.g., coal to gas), or no carbon at all (e.g., hydro, wind, or solar). Those higher prices also would encourage firms and consumers to find ways to use less energy, through various improvements in energy efficiency. Higher energy prices also would raise the prices of goods produced using energy, which would lead consumers to shift toward goods that were less energy intensive. These effects also will have implications for Canada's competitive position in world markets.

Depending on how difficult firms and consumers found it to reduce the use of carbon-based fuels, the coupons could become very valuable. Thus, if they were allocated free of charge, as proposed above for SO_2, producers and importers would reap substantial windfalls. It seems unlikely that such a situation would prove acceptable politically. As a result, it seems more likely that the gains to coupon holders would be taken away, either by a tax on the coupons, or by the government auctioning the coupons to begin with, rather than distributing them free of charge.

3. Carbon Tax

A carbon tax would work essentially the same as a carbon trading system. It too could be administered primarily at the producer/importer level, with rebates for exports and the other cases described above. A carbon tax would have the same impacts on firms and consumers as a coupon system in which the number issued yielded the same price as the tax; the prices of carbon-based fuels would rise to reflect the tax. If the coupons were auctioned or taxed, they also would yield the same revenues for the government as a carbon tax. Thus, it seems likely that carbon trading and a carbon tax would be much more similar than one might initially suppose.

The primary difference would arise in how the two different instruments would respond to uncertainty. Carbon trading would set the quantity, but the price of the coupons would vary depending on the actual marginal costs of reducing carbon. In contrast, a carbon tax would set the price, but total emissions would vary with the costs of reduction. For example, if the cost of reducing carbon use proved to be higher than expected, the price of the coupons would go up, while with a tax the level of emissions would be higher than expected. Conversely, if the cost of reducing carbon were lower than expected, the price of coupons would fall, while a tax would achieve a lower emission level. Whether the flexible response of the quantity under a tax is desirable depends on various factors. In the case of SO_2, we argued that such flexibility probably would *not* be desirable, because the goal has been set in terms of a quantity. In the case of CO_2, it is less clear; the costs of reducing emissions are poorly understood, and there may be more willingness to let the emission target (or at least the pace at which it is achieved) be determined in part by how costly it

proves to be to use less carbon. On the other hand, if fixed targets are negotiated internationally, the certainty offered by tradable coupons is likely to be important.

A carbon tax or auctioned carbon coupons both would raise large revenues for the government(s) that imposed them. The distributional effects of the policy and its overall macroeconomic impacts would depend critically on how the revenues were used. Many observers have suggested that the revenues from a carbon tax be devoted to environmental purposes. The other major alternative would be to use the revenues to automatically reduce other taxes. Reducing such taxes would have two major beneficial impacts: it would minimize the negative macroeconomic effects of a tax increase and it could offset much of the negative effect of a carbon tax on the ability of Canadian products to compete in international markets.

4. International Trading

Market-based approaches also might be extended to the international level. Taxes are unlikely to be very viable (who would collect the revenue?), but a form of coupon trading could be used in conjunction with negotiated targets. Some form of international trading—implicit or explicit—seems critical if cost-effective reductions are to be achieved.

Market-based approaches also might be extended to cover other greenhouse gases (such as methane) and sinks of greenhouse gases (such as forests). Ideally such extensions would be integrated with the system used for carbon—based on the relative effects of different gases—but full integration may prove infeasible.

5. Concluding Remarks

Global warming presents policy makers with a series of difficult choices, beginning with the basic question of whether to take action now to reduce emissions or to await better information. Even the best designed economic instruments do not provide an answer to this basic question, or to many of the other dilemmas involved in formulating policies to deal with global warming. Among the most critical of those issues is the coordination of actions internationally, to ensure effectiveness in achieving desired reductions and to minimize adverse impacts on Canada's ability to compete in world markets. However, such instruments—in particular tradable carbon coupons or a carbon tax—offer a cost-effective option for Canada if it decides to stabilize or reduce emissions of CO_2. Both would give market forces maximum flexibility to find the least-cost means of reducing CO_2 emissions; they would not require prejudging what methods of reduction will prove to be most cost-effective, nor even the sectors from which reductions are most likely to come. As a result, they also would allow flexibility over time to accommodate innovations that could lead to lower-cost reductions in the future.

Clean Air Strategy for Alberta

NATURAL GAS AND ELECTRIC UTILITY INCENTIVES

Prepared by:
Alberta Department of Energy
Energy Efficiency Branch

May 1991

NATURAL GAS AND ELECTRIC UTILITY INCENTIVES

TABLE OF CONTENTS

	Page
Table of Contents	i
Executive Summary	ii
Objectives	1
Methodology	1
Incentives Table	1
Discussion	2
Conclusion	6
Further Information/Follow Up	6

Appendix I - Incentives Table

Appendix II - Rate Structure Factors which Influence Energy Efficiency

Appendix III - Rate Structure Barriers to Energy Efficiency

Appendix IV - References

Appendix V - Terms of Reference

EXECUTIVE SUMMARY

The objectives of this report were to gather and summarize information on gas and electric utility incentive programs for energy efficiency in North America and to identify any necessary approval procedures in Alberta. The report is one of a series of background papers prepared for the Clean Air Strategy of Alberta.

Information on incentive programs was collected from all utilities in Canada and selected utilities in the United States and summarized in a table. The incentive programs range from information and audit programs, to loans and rebates, to alternative rates. These programs are expanding and changing rapidly.

Organizations involved in the approval processes necessary to establish such incentive programs in Alberta were contacted. The primary approval processes required are: a general rate application with the Public Utilities Board for privately owned utilities and city council approval for municipal-owned utilities.

More detailed information is available from the Alberta Department of Energy, Energy Efficiency Branch.

Objectives:

To gather information and summarize the types of gas and electric utility incentive programs that have been used to encourage energy efficiency. The incentive programs include information, services, grants and special rate structures.

To identify the necessary approval procedures that are required to implement these activities in Alberta.

Methodology:

a) Contacted by telephone all utilities in Canada and some of the utilities in the United States to obtain information on their incentive programs for promoting energy efficiency.

b) Corresponded with all Alberta utilities to obtain current rates and regulations. Followed up with telephone calls to obtain information on energy efficiency incentive programs.

c) Telephoned the Energy Resources Conservation Branch (ERCB), Public Utilities Board (PUB) and municipal-owned utilities to gather information on the approval process in Alberta.

d) Developed a table to summarize the incentive programs from all utilities.

e) Summarized the rate structure barriers to energy efficiency implementation using a format previously used by the Alberta Department of Energy, Energy Efficiency Branch.

Incentives Table:

The table in Appendix I lists the types of incentive programs offered by North American gas and electric utilities. Some supply-side programs have been included because of their potential effect to reduce overall utility cost. All Alberta utilities have been listed first, followed by other Canadian utilities and then the U.S. utilities. If the utility offers a particular type of program it is marked with an "x". If the utility plans a program for the future it is marked with a "p". Detailed information about each program is available at the Alberta Energy Efficiency Branch.

The level of activity indicated by an "x" varies substantially from one utility to another. For example, an "x" under residential audit could mean a simple questionnaire followed by a computer printout to a detailed three-hour visit by a trained auditor.

Efforts were made to confirm specific details relative to each program identified. However, in some instances only telephone overviews were provided thus making it difficult to confirm and evaluate specifics.

Discussion:

A) Introduction:

The interest in encouraging energy efficiency is growing rapidly among utilities. In general, the electric utilities are ahead of the gas utilities in implementing energy efficiency programs. The emphasis on programs is changing from informational programs towards audits and financial incentives like rebates. This report includes some supply-side initiatives like improving generating facilities because they may improve the energy efficiency of the overall system. A description of each type of program is in Section B. A table of the utilities offering each type of program is attached.

The reasons for interest in energy efficiency varies with each utility. Some reasons include improved customer service, the need for reducing the peak demand in their system, the economic viability of demand-side management programs, the need to minimize environmental impacts, and the imposition of regulations by public utility boards/commissions.

The approval process is fairly straightforward and well-known by the utilities. Most incentive programs involve a change in the rate structure and therefore, require public utility board/commission approval or city council approval for municipal-owned utilities. The approval process is described in Section C.

B) Types of Programs:

B1) Information: includes brochures, advertising campaigns, seminars, displays, labelling, case studies, awards and involvement with associations. The intent is to respond to requests for information on energy efficiency and promote the wise use of energy resources. It is a customer service which helps promote the utility as a good corporate citizen.

B2) Technical Assistance: generally offered to larger commercial/industrial customers to help design new facilities, improve the power factor in existing facilities, provide billing analysis or consultation on new technologies. The intent is to provide a customer service which encourages efficient use of energy and saves money for the customer.

B3) Audits: range from computer heat-loss calculations to full-scale technical analysis. Some audits focus on specific processes or sections of buildings. Most audits are free. This is a customer service designed to provide direction to customers on the best methods to achieve energy efficiency.

B4) Research: focuses on gathering data to understand energy end-uses or to develop and evaluate new energy efficient technology. Utilities use the end-use data for developing and evaluating demand-side management (DSM) programs. Utilities endeavour to keep current about new technologies in order to provide services to their customers such as information, technical assistance and audits.

B5) Loans: reduced interest rates or grants to a specified amount are offered to help customers renovate existing buildings or upgrade equipment. As a customer service, utilities may pass on the lower interest rate they receive when borrowing money and help customers improve their facility and reduce energy costs.

B6) Rebates: focused on specific products which have significant energy savings but require some financial incentive to increase adoption. The products are generally not being adopted because the higher initial investment results in payback periods longer than is acceptable to the customer. The most common products for rebate are motors, compact fluorescent lights and refrigerators. Utilities assistance may be able to create sufficiently large markets which may reduce capital costs due to increased production, thus reduce the utilities overall demand and benefit the customer through reduced energy bills.

B7) Giveaways: used to promote the utility's services and reduce customer demand immediately with low-cost, easily installed products. The giveaway products include items such as insulation blankets for hot water tanks, water flow restrictors and high-efficiency lights.

B8) Fuel Switching: although most utilities use fuel switching as a method of increasing their customer base, a few such as B.C. Hydro encourage customers to switch from electricity to gas to reduce demand.

B9) Rates: reduced rates are offered to large commercial and industrial users to influence their energy use or entice them to switch use to off-peak hours. A few utilities are considering levelling the rate structure or increasing the rate as consumption increases. These measures should result in increased adoption of energy efficiency techniques and a decrease in overall demand.

B9.1) Interruptible Rates: offered to control peak loading. A contractual arrangement allows the utility to interrupt service on short notice, generally in peak-load seasons or times, in exchange for a preferred rate. The length and time of interruption can vary from during an emergency only to during every peak-load period.

B9.2) Time-of-Use Rates: used to shift load from on-peak to off-peak hours. The billing rate is modified for different time periods throughout the day.

B9.3) Other Rates: include ratchet buydown, power factor correction, dual energy systems and increasing versus decreasing energy charges.

- Ratchetting refers to billing a customer based on the highest electrical demand used in the last 12 months if it exceeds current demand. The ratchet buydown allows customers with significant demand variations to enter a contract to reduce the demand charge.

- If a company improves its power factor some utilities will change the billing demand charge immediately rather than at the end of a ratchet.

- For companies with dual energy systems the utility will give a differentiated rate if the company switches away from using the utility's energy during peak periods. For space heating an outdoor temperature probe could switch fuels at a prescribed temperature.

- A structure which increases the rate as consumption increases is being considered by some utilities.

B10) Cogeneration: is the simultaneous production of both electric and thermal energy from a single fuel source. The potential is large in many areas and is being studied by many utilities. Some utilities have established purchase policies but few sites exist. In the long term, cogeneration may provide an opportunity to diversify supply. The cogeneration referred to in this study is not dedicated electrical supply generation but electrical generation in conjunction with regular facility/plant activities.

B11) Interconnections between Utilities: can help meet peak loading without constructing new supply facilities. They may also be used for reserve or base load.

B12) Improving Generating Facilities: most utilities have in-house programs to maintain productivity. However, some utilities have established aggressive programs to increase efficiency. Examples include replacing turbines, raising reservoirs, and auditing of generating facilities. These programs help reduce the utility's costs and set an example for their customers.

B13) Improving Distribution System: another in-house program which most utilities pursue as a normal course of business but some utilities have aggressively pursued. Potential methods include using larger conductors and voltage stabilization techniques.

B14) Independent Small Power Producers: rates and regulations have been established in many regions. Most small power producers are windmills, small- head hydro, waste fuel or biomass projects. Utilities are interested in the long-term potential to supply future load growth while diversifying their supply system.

C) Approval Process in Alberta:

Most utility incentive programs affect the rate structure and therefore have to be approved by the Public Utilities Board (PUB) if it has jurisdiction over the utility, or city council for municipal-owned utilities.

To apply for a rate change with the PUB the utility must submit a written application to the board secretary. The application must contain enough information so the PUB can thoroughly review the financial position of the utility company and the appropriateness of the new rates being requested. The board may request further materials.

The board, at its discretion, may order a prehearing conference to identify potential participants, clarify issues and gather more information. The board then sets a hearing date, time and place, and drafts a notice. The board instructs the utility to notify affected parties by newspaper advertisements or by serving the application directly. There must be at least five clear days, excluding Sundays and holidays, between the notice and the hearing.

Any authorized representatives of an interested party can appear before the board. At the hearing, any parties involved in the hearing are given an opportunity to present evidence and to examine and cross-examine witnesses. A transcript of the hearing is taken and can be inspected by any member of the public at the board's office.

The board members who heard the case deliberate and make decisions. General rate cases are decided in two phases. The first determines a reasonable rate of return for the company. The second sets the rate design for each customer class which will provide the required revenue based on the rate of return. The board provides a written decision to all participants. Decisions may be appealed to the Court of Appeal on questions of law or jurisdiction. The procedural requirements of the board are contained in the Administrative Procedures Act, 1980. The board may vary the procedure to meet the special needs of a particular application.

For municipal-owned utilities a report is prepared for city council discussing the program changes and the costs and benefits. The council then makes the decision or requests more information.

Conclusion:

Utility incentive programs are expanding and changing rapidly. Many electric utilities have long-term demand-side management plans which are just starting. Gas utilities are currently investigating the need to develop long-term demand-side management plans.

Further Information/Follow-Up:

The Alberta Department of Energy, Energy Efficiency Branch has a library of information on utility energy efficiency programs. The Branch also has the Alberta current rates and regulations on file. It also has a computerized rate program which is used to complete energy audits of commercial and institutional buildings, and industrial plants and can be used to compare and evaluate rates.

For further information on energy efficiency activities and programs, contact the Alberta Department of Energy, Energy Efficiency Branch at 7th floor, 9945 -108 Street, Edmonton, Alberta, T5K 2G6 (403-427-5200).

For more detailed information on the approval processes in Alberta contact the Public Utilities Board. The PUB has pamphlets on the approval process. Contact the PUB at 11th floor, 10055 - 106 Street, Edmonton, Alberta, T5J 2Y2 (403-427-4901).

Appendix I

Energy Efficiency Utility Incentive Programs

Incentive Programs		Alberta Power	City of Calgary	City of Edmonton	City of Lethbridge	City of Medicine Hat	City of Red Deer	Trans Alta Utilities	Canadian Western Natural Gas	Medicine Hat Gas	Northwestern Utilities	Centra Gas (I.C.G.)
Information	Residential	x	x	x			p	x	x		x	
	Commercial	x	x	x		x		x				
	Industrial	x	x	x		x		x				
	Schools	p	x	x				x				
Technical	Residential											
	Commercial	x	x	x		x		x	x			
	Industrial	x	x	x		x		x	x			
Audits	Residential										x	
	Commercial											
	Industrial											
Research	Residential											
	Commercial		x	x					x			
	Industrial	x		x				x	x			
Loans	Residential											
	Commercial											
	Industrial											
Rebates	Residential							p				
	Commercial	p	p	p			p	x				
	Industrial	p	p	p			p	x				
Giveaways	Residential											
	Commercial											
	Industrial											
Fuel Switching												
Rates	Interruptible	x	x	x				x				
	Time-of-use	x	x	x	x			x				
	Other						x					
*Cogeneration		x	x								x	
*Interconnection		x	x	x				x				
*Improving Administrative and Generating Facilities												
*Improving Distribution System												
*Independent Power Producers		x	x					x				

x Utility is delivering an incentive program
p Utility has proposed to deliver an incentive program
* Supply side program

Appendix I

Appendix I

Energy Efficiency Utility Incentive Programs

Incentive Programs		B.C. Hydro	West Kootenay Power	B.C. Gas	Northland Utilities(BC)	Centra Gas(BC)	Pacific Northern Gas	Saskpower	Saskenergy	Manitoba Hydro	Centra Gas (Manitoba)	Ontario Hydro	Consumer Gas	Centra Gas (Ontario)
Information	Residential	x	x	x	x		x	x		x		x		x
	Commercial	x	x					x		x		x		
	Industrial	x	x					x		x		x		
	Schools	x												
Technical	Residential													
	Commercial	x						x				x	x	
	Industrial	x	x					x				x		
Audits	Residential	x	x							x		p		
	Commercial	x	p							x		p		
	Industrial	x	p									p		
Research	Residential			x						x		x	x	
	Commercial									x		x	x	x
	Industrial											x		x
Loans	Residential	x	x					x		x				x
	Commercial							x						
	Industrial													
Rebates	Residential	x	x					x		x		x		
	Commercial	x	x							p		x		
	Industrial	x	x									p		
Giveaways	Residential	x	x	x								p		
	Commercial		x							x				
	Industrial		x											
Fuel Switching		x												
Rates	Interruptible							x		p				
	Time-of-use							x				x	x	
	Other	x												x
*Cogeneration		x										x	x	p
*Interconnection		x								x				
*Improving Administrative and Generating Facilities		x	x							x		x		
*Improving Distribution System		x								x				
*Independent Power Producers		x	x					x		x		x		

x Utility is delivering an incentive program
p Utility has proposed to deliver an incentive program
* Supply side program

Appendix I

Energy Efficiency Utility Incentive Programs

Incentive Programs		Union Gas	Hydro-Quebec	Gaz Metropolitan	New Brunswick Power	Maritime Electric	Nova Scotia Power	Newfoundland Light and Power
Information	Residential	x	x		x	x	x	x
	Commercial		x	x	x	x	x	
	Industrial		p	x	x	x	x	
	Schools		p					
Technical	Residential		p					
	Commercial		p	x	x	x	x	
	Industrial		p					
Audits	Residential		p		x	p	x	
	Commercial		p		x	p	x	
	Industrial		p					x
Research	Residential	p	p		x		x	x
	Commercial		p		x		x	x
	Industrial	x	p				x	x
Loans	Residential				x			
	Commercial			x	x			
	Industrial			x	x			
Rebates	Residential	x	p		x	x		x
	Commercial		p			p		
	Industrial		p			p		
Giveaways	Residential	x	p					
	Commercial				x			
	Industrial							x
Fuel Switching								
Rates	Interruptible	x	x	x	x	x	x	
	Time-of-use		p			x		
	Other		x					
*Cogeneration		x	x			x	x	x
*Interconnection						x		
*Improving Administrative and Generating Facilities			p					
*Improving Distribution System								
*Independent Power Producers					x	x	x	x

x Utility is delivering an incentive program
p Utility has proposed to deliver an incentive program
* Supply side program

Appendix I

Energy Efficiency Utility Incentive Programs

Incentive Programs		Consumers Power (Michigan)	Michigan Consolidated Gas	Montana Power	Long Island Lighting (NY)	National Fuel Gas Distribution (NY)	Bonneville Power Administration(Ore)	Pacific Gas and Electric(Calif)	Puget Sound Power and Light(Wash)
Information	Residential	x	x		x		x	x	x
	Commercial				p		x	x	x
	Industrial				p		x	x	x
	Schools				p				
Technical	Residential		x		x		x	x	
	Commercial		x	x	x	x	x	x	x
	Industrial		x	x	x	x	x	x	x
Audits	Residential	x	x	x	x		x	x	x
	Commercial	x	x		x	x	x	x	x
	Industrial				x		x	x	x
Research	Residential	x		x	x		x	x	
	Commercial			x	x		x	x	x
	Industrial						x	x	x
Loans	Residential		x	x					
	Commercial		x						
	Industrial		x						
Rebates	Residential	x	x	x	x		x	x	x
	Commercial	x	x	x	x		x	x	x
	Industrial	x	x	x	x		x	x	x
Giveaways	Residential	x	x	x	x			x	x
	Commercial			x					x
	Industrial			x					
Fuel Switching					x				
Rates	Interruptible				x	x			x
	Time-of-use				x			x	
	Other				x	x			x
*Cogeneration						x			x
*Interconnection									
*Improving Administrative and Generating Facilities									
*Improving Distribution System									
*Independent Power Producers								x	

x Utility is delivering an incentive program

p Utility has proposed to deliver an incentive program

* Supply side program

Appendix I

Energy Efficiency Utility Incentive Programs

Incentive Programs		Duke Power(NC)	Washington Gas	Southern California Gas	New England Electric System	Pacific Power(Utah)	Wisconsin Electric Power	Southern California Edison	Sierra Pacific Power(Nevada)	Central Maine Power
Information	Residential	x		x	x	x	x	x	x	x
	Commercial	x		x			x	x	x	x
	Industrial	x		x			x	x	x	x
	Schools								x	
Technical	Residential	x			x	x	x	x	x	x
	Commercial	x		x	x	x	x		x	x
	Industrial	x			x		x		x	
Audits	Residential	x	x	x		x		x	x	x
	Commercial	x	x	x	x				x	x
	Industrial	x		x	x				x	x
Research	Residential			x						x
	Commercial			x					x	x
	Industrial			x					x	x
Loans	Residential	x	x			x				x
	Commercial						x			x
	Industrial						x			x
Rebates	Residential	x	x	x	x	x	x	x	x	x
	Commercial		x	x	x	x	x	x	x	x
	Industrial		x	x	x	x	x	x	x	x
Giveaways	Residential			x	x	x	x		x	x
	Commercial		x		x			x		x
	Industrial				x					
Fuel Switching										
Rates	Interruptible	x					x		x	x
	Time-of-use	x					x	x	x	x
	Other	x						x		x
*Cogeneration			x				x			x
*Interconnection										x
*Improving Administrative and Generating Facilities					x				x	
*Improving Distribution System									x	
*Independent Power Producers										x

x Utility is delivering an incentive program
p Utility has proposed to deliver an incentive program
* Supply side program

Appendix II

Rate Structure Factors which Influence Energy Efficiency

Current rate structure designs have evolved to meet the objectives of generating the required revenues for the utilities while focusing on the optimization, where feasible, of economic efficiency. In some instances this focus results in disincentives (or barriers) to the promotion of energy efficiency and/or conservation.

A barrier in this appendix is a restriction or signal given by a rate which discourages a utility customer from taking energy efficiency measures. Each barrier is described as it is listed on the left side of the table in Appendix III. For each utility the table identifies the specific rate structures which correspond with each barrier.

It should be noted that rate structures are developed as a package and not in isolation. Therefore, the barriers identified in the table exist but should be analyzed in the context of system and customer load characteristics.

Electrical

1. Minimum charges associated with a minimum amount of energy being used.

   - Using a minimum rather than a fixed-charge results in no incentive to not use the energy in the minimum block as it will be paid for whether used or not.

2. Minimum blocks of energy or demand.

   - Again, eliminates incentive to reduce energy use as well as reduce demand levels as the minimum amount will be charged anyway.

3. Using the highest reading during a 12-month period for billing purposes, known as ratchetting.

   - This is associated with demand rate structures and after a peak has been established would result in no incentive to decrease electrical demand and reduced incentive to decrease energy use.

4. Billing-on-demand rate structures without the use of a demand meter.

   - Estimates based on connected load or energy used may not reflect the actual demand and provide reduced incentive to decrease the demand.

5. Billing structures which have energy blocks which are demand related.

   - High demand and low energy usage on such structures result in little inducement to reduce demand (the exact opposite of the intent of a demand rate structure).

6. Demand discounts either on a seasonal basis or generally.

   - During periods when the discount applies, there is reduced incentive to limit or decrease energy use.

7. Block structures with lower levels of cost for increased energy and/or demand.

   - For larger users which are more likely to be in the position to implement conservation measures, the benefit is minimized because of the lower costs associated with high usage.

8. Demand billing structures which bill in Kw (kilowatts) but meter in kVA (kilo volt-amperes).

   - This tends to create confusion especially if a kVA meter is used for demand readings as clients are less aware that benefits from demand management such as power factor correction are still possible.

9. Demand billing structures which are metered in Kw.

   - As power factor is not recorded, thus not billed, there is no incentive to improve poor power factor.

10. Lack of rate structures which encourage conservation and/or alternate sources of energy.

    - Rate structures such as time of day (night costs different from day costs) and energy banking (putting energy into the system at one time and taking it out at another) may encourage conservation and support development of alternate sources of energy.

Natural Gas

1. Block structures with lower levels of cost for increased energy usage.

   - For larger users which are more likely to be in the position to implement conservation measures, the benefit is reduced because of the lower cost associated with high usage.

2. Different rate structures for different users -- the larger user receives a rate which has lower costs per unit of energy.

   - The resulting effect is similar to 1.

3. High load factor rate structures with lower costs for users who ensure that 40 per cent of consumption occurs in the summer, and penalties if the usage ratio is not maintained.

   - Encourages inefficiency to ensure that the usage ratio is maintained.

4. Penalty charges for not using the required amount of energy stipulated in the rate.

   - The effect is to penalize and discourage reduced usage.

5. Using the highest amount of gas delivered during a 12-month period for billing purposes, known as ratchetting.

   - This is associated with billing demand and results in no incentive to reduce gas demand and minimizes incentive to reduce energy use after a peak has been established.

Appendix IV

References

A) Author

- Goldie Edworthy
  Alberta Department of Energy

B) Resource People

- Wayne Taylor
  Electric Utilities Planning Council
- Larry Charach
  Alberta Department of Energy
- Larry Bruce
  Northwestern Utilities Limited
- Ammon Ackroyd
  Public Utilities Board
- Rob MacIntosh
- Alberta Environmental Network
- Doug Bruchet (Jim Swiss)
  Canadian Petroleum Association

C) Utilities Contacted

- (Utilities are listed in same sequence as Incentives Table in Appendix I)

Alberta Power Limited
10035 - 105 Street
Edmonton, Alberta
T5J 2V6
Telephone: 403-420-7310

The City of Calgary Electric System
Box 2100, Station M
Calgary, Alberta
T2M 2M5
Telephone: 403-268-2923

Edmonton Power
Capital Square
10065 Jasper Avenue
Edmonton, Alberta
T5J 3B1
Telephone: 403-448-3000

City of Medicine Hat Electric System
580 First Street S.E.
Medicine Hat, Alberta
T1A 8E6
Telephone: 403-529-8257

TransAlta Utilities
P.O. Box 1900
110 - 12 Avenue S.W.
Calgary, Alberta
T2P 2M1
Telephone: 403-267-4916

Medicine Hat Gas
364 Kipling Street S.E.
Medicine Hat, Alberta
T1A 1Y5
Telephone: 403-529-8248

Centra Gas (Alberta) Ltd.
Box 800
5509 - 45th Street
Leduc, Alberta
T9E 3N3
Telephone: 403-986-5215

West Kootenay Power Ltd.
P.O. Box 130
Trail, British Columbia
V1R 4L4
Telephone: 604-368-3321

City of Lethbridge Power
City Hall
910 - 4th Avenue South
Lethbridge, Alberta
T1J 0P6
Telephone: 403-320-3930

City of Red Deer Electric Systems
Box 5008
Red Deer, Alberta
T5N 3T4
Telephone: 403-342-8274

Canadian Western Natural Gas Company Limited
909 - 11th Avenue S.W.
Calgary, Alberta
T2R 1L8
Telephone: 403-245-7710

Northwestern Utilities Limited
10035 - 105 Street
Edmonton, Alberta
T5J 2V6
Telephone: 403-420-7211

B.C. Hydro
970 Bernard Street
Vancouver, British Columbia
V62 1Y3
Telephone: 604-663-3245

British Columbia Gas
Suite 3200
1066 West Hastings Street
Vancouver, British Columbia
V6E 3G3
Telephone: 604-684-0484

Northland Utilities (B.C.) Ltd.
1208 - 102 Avenue
Dawson Creek, British Columbia
V1G 2C4
Telephone: 604-782-7325

Pacific Northern Gas Ltd.
Suite 1400
1185 West Georgia Street
Vancouver, British Columbia
V6E 4E6
Telephone: 604-691-5680

SaskEnergy Corporation
P.O. Box 3839
2221 Cornwall Street
Regina, Saskatchewan
S4P 3R8
Telephone: 306-777-9200

Centra Gas (Manitoba) Ltd.
444 St. Mary Avenue
Winnipeg, Manitoba
R3C 3T7
Telephone: 204-944-9920

Consumer Gas
100 Simcoe Street
Toronto, Ontario
M5H 3G2
Telephone: 416-492-5000

Union Gas Limited
Box 2001
50 Keil Drive North
Chatham, Ontario
N7M 5M1
Telephone: 519-352-3100

Gas Metropolitan
1717, Rue du Havre
Montréal, Quebéc
H2K 2X3
Telephone: 514-598-3444

Centra Gas (B.C.) Ltd.
110 - 800 Tolmie Avenue
Victoria, British Columbia
V8X 3W4
Telephone: 604-754-5561

SaskPower
2025 Victoria Avenue
Regina, Saskatchewan
S4P 0S1
Telephone: 306-566-2117

Manitoba Hydro
P.O. Box 815
Winnipeg, Manitoba
R3C 2P4
Telephone: 204-474-3341

Ontario Hydro
(C27-B1) 700 University Avenue
Toronto, Ontario
M5G 1X6
Telephone: 416-592-4766

Centra Gas (Ontario) Ltd.
245 Yorkland Blvd.
North York, Ontario
M2J 1R1
Telephone: 416-496-5222

Hydro-Quebec
75 Boulevard René Levesque Ouest
Montréal, Quebéc
H2Z 1A4
Telephone: 514-289-3439

New Brunswick Power
P.O. Box 2000
Fredericton, New Brunswick
E3B 4X1
Telephone: 506-458-4327

Maritime Electric Company, Limited
P.O. Box 1328
Charlottetown, Prince Edward Island
C1A 7N2
Telephone: 902-566-1599

Newfoundland Light and Power
P.O. Box 8910
St. John's, Newfoundland
A1B 3P6
Telephone: 709-737-2853

Nova Scotia Power Corporation
P.O. Box 910
Halifax, Nova Scotia
B3J 2W5
Telephone: 902-428-6455

Consumers Power Company
212 W. Michigan Avenue; H-509
Jackson, Michigan
49201
Telephone: 517-788-0551

Michigan Consolidated Gas Company
500 Griswold; GB22
Detroit, Michigan
48226
Telephone: 313-256-5644

Long Island Lighting Company
99 Sunnyside Blvd.
Woodbury, New York
11797
Telephone: 516-364-7722

Montana Power Company
ECCP
40 East Broadway
Butte, Montana
59701
Telephone: 403-723-5421

National Fuel Gas Distribution
10 Lafayette Square
Room 800
Buffalo, New York
14203
Telephone: 800-433-0177

Bonneville Power Administration
905 N.E. 11th Street
P.O. Box 3621
Portland, Oregon
97208-3621
Telephone: 503-230-3000

Puget Sound Power and Light Company
P.O. Box 97034
Bellevue, Washington
98009 - 9734
Telephone: 206-462-3739

Pacific Gas and Electric Company
123 Mission
Room 2657
San Francisco, California
94106
Telephone: 415-973-8575

Duke Power
P.O. Box 33189
Charlotte, North Carolina
28242
Telephone: 704-373-4945

Washington Gas
6801 Industrial Road
Springfield, Virginia
22151
Telephone: 703-750-7538

New England Electric System
25 Research Drive
Westborough, Massachusetts
01582-0099
Telephone: 508-366-9011

Wisconsin Electric Power Company
P.O. Box 2046
Milwaukee, Wisconsin
53201
Telephone: 414-221-4900

Sierra Pacific Power Company
P.O. Box 10100
Reno, Nevada
89520
Telephone: 702-689-4242

Southern California Gas Company
Box 3249
810 South Flower Street
Los Angeles, California
90051
Telephone: 213-895-5172

Pacific Power
920 S.W. Sixth Avenue
Portland, Oregon
97204
Telephone: 503-464-5000

Southern California Edison
P.O. Box 800
2244 Walnut Grove Avenue
Rosemead, California
91770
Telephone: 800-952-5062

Central Maine Power Company
Edison Drive
Augusta, Maine
04336
Telephone: 207-623-3521

Appendix V

Inventory of
Natural Gas And Electricity Utility Incentives
Terms of Reference

Objective:

To gather details on the types of gas and electric utility incentive programs (including general rate structures) that have been used to encourage energy efficiency, as well as regulatory inducements to offer such programs.

To identify the necessary approval processes that are required in implementing these types of activities in Alberta.

Proposed Methodology:

a) Contact Canadian and U.S. sources in order to obtain copies and compile an inventory of gas and electric utility incentive programs (including loans, energy audits and general rate structures) that promote energy efficiency. Attempt to gather relevant information from other countries if possible.

b) Develop an inventory of utility incentive programs that are in use in Alberta.

c) Prepare a summary of rate structure barriers to conservation implementation.

d) Arrange an informal meeting with utility, Public Utilities Board, and Alberta Department of Energy's Utility Policy Group representatives in order to identify the approval mechanisms and/or procedures for utility companies to implement incentive programs in Alberta.

Scope:

The scope of this activity is limited to utility customer-oriented incentives, general (not specific) rate structures and any other innovations used to encourage energy efficiency and associated environmental benefits.

Anticipated Output:

The output of the study will consist of an approximately six-page report which will include:

- a listing of the types of programs and a brief description of each type including their intent
- a matrix or appropriate listing format indicating which utilities offer which type of programs
- a listing of Alberta programs and the utilities offering them
- a brief description of the approval process required for utilities to offer incentive programs
- the detailed information obtained regarding programs to be retained in reference library.

Coordinator:

Les Sladen (Alberta Department of Energy)

Resource People:

Al Brekke (Electric Utilities Planning Council)
Larry Charach (Alberta Department of Energy)
Larry Bruce (Northwestern Utilities Limited)
Ammon Ackroyd (Public Utilities Board)
Rob MacIntosh (Alberta Environmental Network)
Doug Bruchet (Canadian Petroleum Association)
Goldie Edworthy (Alberta Department of Energy)

Clean Air Strategy for Alberta

ENERGY EFFICIENCY LEGISLATION IN ALBERTA AND OTHER JURISDICTIONS

Prepared by:
Alberta Department of Energy
Energy Efficiency Branch

May 1991

ENERGY EFFICIENCY LEGISLATION IN ALBERTA AND OTHER JURISDICTIONS

TABLE OF CONTENTS

	Page
Table of Contents	i
Executive Summary	ii
Objectives	1
Methodology	1
Discussion	1
What is Regulated?	3
Conclusion	3

Appendix I - Tables 1 and 2 - Survey Summary

Appendix II - Elaboration of - What is Regulated - in Tables 1 and 2

Appendix III - Outline of Existing Legislation in Canada, U.S.A., and other countries

Appendix IV - Resource Persons

Appendix V - Terms of Reference

EXECUTIVE SUMMARY

The objective of this report was to gather and summarize legislation in Alberta and other federal, provincial or state jurisdictions which addresses the issue of efficient use of energy. This report was undertaken at the request of the Clean Air Strategy for Alberta.

Information on existing legislation was collected from the federal government, all the provinces and Northwest Territories in Canada and from selected states in the United States. The results are summarized in a table. The legislation regulations range from appliance efficiency standards to extensive weatherization standards in residential and commercial buildings. The legislation and regulations are expanding and changing rapidly.

Organizations involved in the development and delivery of the legislation were contacted.

More detailed information is available from the Alberta Department of Energy, Energy Efficiency Branch.

Objective:

To compile a listing of existing and proposed legislation in Alberta and other federal, provincial or state jurisdictions which addresses the issue of efficient use of energy.

The statutes listed include both general statements and specific requirements such as the use of appliance standards.

The statutes and regulations listed in Appendix III are limited to those that make direct reference to increased energy efficiency.

Methodology:

To obtain outlines of existing legislation in Alberta and other federal, provincial or state jurisdictions which contain elements to promote the wise use of energy. To gather information from other countries if possible.

Discussion:

Canada

All the provinces were contacted, including the Northwest Territories. No national statute which regulates energy efficiency was found as of this writing, however under the Consumer and Packaging Act of 1978 some labelling on large household appliances is required. The labelling indicates how much energy the appliance uses. It should be noted that in Canada because of jurisdictional separations, national statutes may not be applicable.

British Columbia, Ontario and Quebec have statutes and regulations in place. These are summarized in Appendix III.

All the other provinces and territories have no statutes and regulations as of this writing.

There are building codes; either adopted National Research Council, provincial or municipal, which can be interpreted in some ways as promoting energy efficiency.

United States of America

The U.S. Department of Energy (DOE) and several states were contacted. To give a cross-section of the U.S., the states contacted were Alaska, Arizona, California, Florida, Pennsylvania, Iowa, New York and Wisconsin. The statutes and regulations are summarized in Appendix III.

The U.S. Government has legislation governing appliances and motor vehicle efficiencies. Many of the states have enacted their own legislation promoting energy efficiency.

Other Jurisdictions

A recent publication from the Ontario Ministry of Energy *International Review of Regulations and Programs in Energy Conservation*, April 1990 contains information on energy efficiency legislation from many countries. Appendix III summarizes the findings. The countries include Belgium, France, Germany, Sweden, Switzerland, United Kingdom, Japan, Denmark, Italy and Norway.

Public Utilities

In Alberta and the rest of Canada, the public utilities have been providing voluntary energy savings incentives via rate schedules, grants and programs.

Some public utilities in the United States are required by state legislation to provide energy management programs, more commonly known as demand-side management. New York State public commission requires all state utilities to deliver free energy audits. The Pacific Northwest Electric Power Planning and Conservation Act requires the Bonneville Power Administration to consider energy conservation as an energy resource. Bonneville Power Administration coordinates the supply of electricity in Washington, Oregon, Idaho and Montana states.

Also see the *Natural Gas and Electric Utility Incentives*, May 1991 paper which summarizes public utility programs which encourage the wise use of energy.

Environmental Emissions Acts and Regulations

There are statutes in all regions which regulate emissions from residential, commercial, industrial and transportation sectors. Many can be interpreted as an indirect method of improving energy efficiency (ie. reduced emissions from vehicles can be related to reduced fuel consumption). The intent of the statutes is to reduce air pollution and to address environmental concerns. This summary of legislation does not include environmental protection statutes, as they do not clearly define energy efficiency as a purpose.

What is Regulated?:

This study does not endeavour to identify, record or interpret government policy in different jurisdictions, only to identify legislation that has been established relative to energy efficiency.

Two tables have been generated and are intended to show what is legislated. The tables can be found in Appendix I.

Table 1 Results of Survey summarizes Canadian federal and provincial legislation.

Table 2 Results of Survey summarizes U.S. federal and state legislation.

After reviewing all the statutes and regulations, the categories below What is Regulated? on Tables 1 and 2, Appendix I were selected as main titles. The main titles are expanded in Appendix II. This was done to simplify the tables.

The term "statute" refers to an act or bill which has been legislated by elected officials.

The term "regulation" refers to the rules that are subsequently enacted in a given statute.

Conclusion:

In Canada there are three provinces which have legislation regulating energy efficiency; British Columbia, Ontario and Quebec. There is no federal statute at this writing.

In the U.S. there is federal legislation and many state-level statutes and regulations. The acts and regulations affect a wide variety of energy conservation measures, from improved appliance efficiency to total building weatherization.

Further Information/Follow-Up:

For further information on energy efficiency activities and programs, contact the Alberta Department of Energy, Energy Efficiency Branch at 7th floor, 9945 - 108 Street, Edmonton, Alberta, T5K 2G6 (403-427-5200).

Appendix I

Table 1 Results of Survey Canada

Description	Canada / Provinces & Territories				
	British Columbia	Manitoba	Ontario	Quebec	Federal
Statute(s)	X	X	X	X	X
What is Regulated?					
Appliances	X		X		
Building Envelope	P		X	X	
Warm Air Heating Equip. & Systems	X		X	X	
Ventilation Equip. & Systems				X	
Cooling Equip. & Systems	X		X	X	
Plumbing Equip. & Systems	X		X	X	
Lighting	P			X	
Electrical Systems				X	
Electric Motors	I				
Small Energy Using Products			P		
Labels	X		X		X
Programs					
Transportation					
Government Leased/Owned Facilities					
Miscellaneous					
Non-essential Natural Gas Use				X	
Enforcement - Fine Offence	O		F		

X = Regulations in Place
P = Proposed Regulations
I = Industrial Only
O = Offence
F = Fines
? = unknown

Note: This study does not endeavour to identify, record or interpret government policy in different jurisdictions, only identify legislation that has been established relative to energy efficiency. The provinces listed are the only provinces in Canada with energy efficiency statutes (including the territories).

Appendix I

Table 2 Results of Survey USA

Description		USA								
		Alaska	Arizona	California	Florida	Pennsylvania	Wisconsin	Iowa	New York	Federal
Statute(s)		X	X	X	X	X	X	X	X	X
What is Regulated?										
	Appliances		P	X	X		X		X	X
	Building Envelope	X	P	X	X	X	X	X	X	
	Warm Air Heating Equip. & Systems		P	X	X	X	X		X	X
	Ventilation Equip. & Systems	X	P	X	X	X	X		X	
	Cooling Equip. & Systems		P	X	X	X	X		X	X
	Plumbing Equip. & Systems		P	X	X	X	X		X	X
	Lighting		P	X	X	X	X	X	X	
	Electrical Systems					X				
	Electric Motors								X	
	Small Energy Using Products			X			X	X	X	X
	Labels									
	Programs	X	P	X	X		X	X	X	
	Transportation		P	X		P		X		X
	Government Leased/Owned Facilities	X	P	X	X	X		X		
	Miscellaneous	X		X	X	X			X	
	Non-essential Natural Gas Use						X			
	Enforcement - Fine/Offence	?		F	F	F	F	F	F	?

X = Regulations in Place
P = Proposed Regulations
I = Industrial Only
O = Offence
F = Fines
? = unknown

Note: Twelve states were contacted, the table includes only those that responded. The table does not reflect all the statutes and regulations relative to energy efficiency that can be found in the USA, but rather a representative sampling.

Appendix II

What is Regulated?

All the statutes and regulations for each federal, provincial or state jurisdiction that responded to the survey were reviewed. Main titles were selected to easily identify what is affected. The following list summarizes what items are included under each of the main titles found in Tables 1 and 2 Appendix I.

Appliances

- clothes dryers, washers.
- dishwashers.
- refrigerators, freezers.
- ranges, ovens.

Building Envelope

- thermal performance indices.
- thermal resistance (R-values) or insulation of walls, windows, roof, crawl spaces.
- air leakage (infiltration rates).
- designs must be submitted to meet thermal performance indices on renovation projects.

Warm Air Heating Equipment and Systems

- design requirements.
- performance guidelines i.e. combustion efficiency, coefficient of performance.
- system controls (i.e. temperature, humidity, temperature zoning, set-back, shut-off, outside temperature automatic reset control).
- piping insulation.
- forced air furnaces, boilers, heat pumps.
- electronic ignition.
- flue dampening.

Ventilation Equipment and Systems

- controls.
- design (i.e. reheat, multi-zone, dual duct).
- duct insulation.
- heat recovery.

Air-Conditioning Equipment and Systems

- design requirements.
- performance guidelines (i.e. energy efficiency ratio, coefficient of performance).
- system controls (i.e. temperature, humidity, temperature zoning, set-back, shut- off).
- central and room air conditioners (i.e. size, efficiency).
- heat recovery.

Plumbing Equipment and Systems

- self-closing outlet devices.
- flow rates (shower and faucet) (i.e. showers < 3 gallons per minute).
- piping insulation.
- tank insulation.
- tank efficiency.
- temperature controls.
- shut-down control (switch, valve).
- circulating pump controls.
- limit pool water temperature (i.e. maximum 27°C).

Electrical Systems

- least lost voltage service.
- voltage drop limited (i.e. 3 per cent in branch circuits, 5 per cent at furthest outlet).
- lighting switches (i.e. to provide for each lighting circuit, partial for custodial, complement natural lighting).
- separate metering for tenants.
- transformers.
- car plugs.

Lighting

- power budget.
- light levels.
- facade lighting (i.e. no greater than 2 per cent of total interior electrical load of building).
- calculation procedures.
- lamp, ballast efficiencies.
- street lighting.

Miscellaneous

- energy conservation manuals for designers, builders, contractors, residential and non-residential buildings.
- educational programs.
- certification (i.e. inspection, energy audits).
- energy conservation fund and trust funds (i.e. where fines are collected and sent). The money may then be used to finance administration of energy conservation.

Electric Motors

- electric motors (i.e. energy efficient versus standard).

Programs

- energy audits and/or energy auditors (i.e. establish minimum requirements for energy auditors).
- public utilities to provide services (i.e. energy audits upon request).
- various sector funds for programs.

Small Energy Using Equipment

- televisions, VCR's.
- computers, copy machines, facsimile machines.
- vending machines.

Labels

- defining energy use/requirements.
- meeting associated energy efficiency standards.
- includes certificates.

Transportation

- tax incentives.
- zero/low emission vehicles.
- travel reduction measures (i.e. parking reduction incentives, ride sharing programs).
- Corporate Average Fuel Economy (CAFE) standards (i.e. fuel efficiency).

Government Leased/Owned Facilities

- facilities must be energy efficient.
- energy management plan.
- energy coordinators.
- employee education.

Non-Essential Uses of Natural Gas

- pool heaters.
- pool covers.
- gas lights.
- snow melting equipment.

Appendix III

Outline of Existing Energy Efficiency Legislation

Canada - Federal Government

Generally, the federal government has no legislative authority over most energy policies as it is a provincial jurisdiction. However, under the Canada Consumer and Packaging Act of 1978 some labelling indicating energy usage is regulated.

Canada - Province of Alberta

While there are no energy efficiency-specific statues in Alberta, there are, however, other provincial acts and legislation that makes reference to energy conservation. The Energy Resources Conservation Board has a mandate which requires resource developments to be efficient, through legislation such as the Oil and Gas Conservation Act 1980. It should be noted that these statutes are not directly related to promotion of conservation by end users.

Canada - Province of British Columbia

Bill 36 - 1990 Energy Efficiency Act

"The Bill promotes energy efficiency and thereby contributes to environmental awareness by establishing energy efficiency standards applicable to the sale, or lease of certain energy using devices including appliances, industrial electric motors, and electrical apparatus. Under this Bill, such energy using devices are required to meet prescribed energy efficiency standards and are labelled accordingly.

It provides for "the inspection and testing of energy using devices manufactured or offered for sale or lease in the province, and for the production of documents relevant to the carrying out of an inspection or test.", quoted from Bill 36 Explanatory Note, page 2.

Bill 36 requires that there be a prescribed label on appliances and products indicating that they conform to the prescribed standards.

The accepted certification agency is the Canadian Standards Association for electrical and oil equipment and the Canadian Gas Association for gas equipment.

Other Acts, Regulation, Etc.

There are proposals to change building codes to promote energy efficiency. Respondents from the British Columbia Ministry of Energy, Mines and Petroleum Resources, Energy Resources Division, Energy Management Branch indicated some American Society of Heating, Refrigerating and Air-Conditioning Engineers, (ASHRAE) standards may be adopted. The standards will effect thermal and lighting aspects of residential and commercial buildings. Details are not available at the time of this report.

There are no transportation legislation initiatives at the provincial level. There are initiatives being taken at municipal government levels (i.e. Vancouver's "Clouds of Change" proposals, detailed information was not available).

Canada - Province of Ontario

Bill 82 (Chapter 32 Statutes of Ontario 1988) An Act Respecting Energy Efficiency

The Act enables the Government of Ontario to introduce regulations to ensure that products sold or leased in Ontario meet minimum levels of energy efficiency. The products specified must also have prescribed labels that set out the efficiency standards.

What is Regulated?

Bill 82 facilitates the implementation of regulations to require appliances and some other products meet specified efficiency standards. The appliances and products described in Section 2 of Bill 82 are: central air conditioners, clothes dryers, clothes washers, dishwashers, freezers, furnaces, heat pumps, ovens, ranges, refrigerators, room air conditioners, pool heaters, water heaters, and other prescribed appliances and products.

Bill 82 requires labelling on appliances and designated products indicating that they conform to the prescribed standards.

The accepted certification agency is the Canadian Standards Association for electrical and oil equipment and The Canadian Gas Association for gas equipment.

Other Acts, Regulations, etc.

The Province of Ontario has building codes which enforce thermal requirements of residential and commercial buildings (i.e. minimum R-values).

Canada - Province of Manitoba

Chapter E112 The Manitoba Energy Authority Act

The Act refers to energy efficiency in remote terms. The stated purpose and objective is "to alleviate the effects of any energy shortage that may occur in the province" and under the powers section to "develop and recommend to the minister of energy, policies for the province including policies relating to the exploration for, production, recovery, manufacture, processing, transmission, distribution, sale, purchase, exchange, disposal, supply, demand, use, conservation, ... of energy."

However officials in Manitoba did mention there are new proposals underway, details of which are not available at this time.

Canada - Province of Quebec

An Act respecting the conservation of energy in buildings, revised statutes of Québec, chapter E-1.1, updated to 15 February 1989, last amendment: 17 April 1987.

The act affects any structure intended for lodging persons, sheltering animals or storing things which is equipped with heating and/or a cooling system except a farm building intended for storage or animal shelter.

Regulation respecting energy conservation in new buildings, Order in Council 89-83, 19 January 1983, (1983) 117 G.O.2, 775, updated to 6 January 1987.

Regulations affect design and construction of buildings.

What is Regulated?

Building envelope, warm air heating equipment and systems, ventilation equipment and systems, air conditioning equipment and systems, plumbing equipment and systems, electric systems, lighting, and non-essential use of natural gas.

United States of America

5.83 [Report No. 100-6], 100th Congress, 1st Session, To amend the Energy Policy and Conservation Act with respect to energy conservation standards for appliances. The short title is "National Appliance Energy Conservation Act of 1987".

What is Regulated?

Refrigerators, refrigerator-freezers, freezers, room air conditioners, central air conditioners, heat pumps, water heaters, furnaces, dishwashers, clothes washers, clothes dryers, direct heating equipment, kitchen ranges and ovens, pool heaters, television sets and "Any other type of consumer product which the secretary classifies as a covered product..."

USA - State of Alaska

Alaska Statute 46.11.040

Legislated in 1980, the statute mandates energy conservation standards for all new residential buildings receiving any form of state funding effective October 1, 1988. Some programs are also mandated.

What is Regulated?

Building envelope, plumbing systems, miscellaneous (i.e. establishment of criteria for energy audits).

USA - State of Arizona

Charter 252, House Bill 2206

"An Act relating to transportation and the environment..."

Public Buildings and Improvements Title 34, Article 3. Energy Conservation and Solar Design Standards

"The department of administration shall adopt and publish energy conservation standards for construction of all new state buildings, including buildings of state-supported institutions of higher education..." "The standards shall be promulgated to achieve energy conservation..."

What is regulated?

Transportation, building envelope, government leased/owned facilities.

Misc.

The state recently published a policy which recommends various legislative action ("Executive Summary - Energy Policy in Arizona: a Plan for Sustainable Development" on file).

USA - State of Iowa

Senate File 2403, An Act Relating to Energy Efficiency

What is regulated?

Building, envelope, labelling, transportation.

USA - State of Pennsylvania

Building Energy Conservation Act, Act of 1980, P.L. 1203, No. 222, Revised March 25, 1985.

"The purpose of this act is to grant to the Department of Labour and Industry and the Department of Community Affairs and direct these departments to exercise specific authority in building construction, to assure that such construction is performed using materials and techniques that will provide for energy conservation in the future operation and maintenance of said buildings"

What is Regulated?

Building envelope, warm air heating, ventilating and air conditioning systems and equipment, plumbing, fixtures (flow rates), electrical systems, lighting, miscellaneous.

USA - State of Florida

Florida Energy Efficiency and Conservation Act Sections 366.8-366.85 and 403.519

"The legislature directs the commission to develop and adopt overall goals and authorizes the commission to require that each utility plans and implements programs for increasing energy efficiency and conservation within its service area."

Florida Energy Conservation in Buildings Act of 1974 Section 255.251

"It shall be the policy of the state that buildings constructed and financed by the state be designed and constructed in a manner which will minimize the consumption of energy used in the operation and maintenance of such buildings."

Florida Thermal Efficiency Code Section 554.9

"The purpose of this thermal efficiency code is to provide for a statewide uniform standard for energy efficiency in the thermal design and operation of all buildings statewide, consistent with energy conservation goals...."

What is regulated?

Appliances, programs, government leased and owned facilities, building envelopes, warm air heating equipment, ventilation equipment and systems, cooling equipment and systems, plumbing equipment and systems, lighting both in residential and nonresidential applications.

USA - State of Wisconsin

Chapter ILHR22 Energy Conservation

"The purpose of this chapter is to provide design requirements which will improve the utilization of energy in one and two family dwellings as defined in s.ILHR22.01, including minimum requirements for material and methods of construction and for heating, cooling and air conditioning equipment and systems."

Chapter ILHR63 Energy Conservation

"The purpose of this chapter is to provide design requirements which will promote efficient utilization of energy in public buildings and places of employment."

Chapter ILHR67 Rental Unit Energy Efficiency Standards

"The purpose of this chapter is to establish rules for the department to enforce s.101.122, Stats."

Chapter ILHR72 Intermittent Ignition Devices for New Residential Gas Appliances

"The purpose of this chapter is to establish standards for the certification of intermittent ignition devices and to prohibit the use of pilot lights on new residential gas appliances in accordance with 101.655, Stats."

Chapter PSC136 Electric and Gas Conservation

"... constitutes a general order of the public service commission... the requirements of ch.PSC136 shall be observed by all public utilities, both privately and owned...."

What is Regulated?

Appliances, building envelopes, warm air heating equipment and systems, ventilation equipment and systems, cooling equipment and systems, plumbing equipment and systems, lighting, and the non-essential uses of natural gas.

USA - State of California

Warren - Alquist State Energy Resources Conservation Act 1990

"It is further the policy of the state and the intent of the Legislature to employ a range of measures to reduce wasteful, uneconomical, and unnecessary, uses of energy, thereby reducing the rate of growth of energy consumption, prudently conserve energy resources, and assure statewide environmental, public safety, and land use goals."

Under the "Warren - Alquist Act", other energy conservation acts are consolidated including: "Chapter 4.7 Motor Vehicle Fuel Conservation Act of 1980" and "Chapter 5.2 Energy Conservation Assistance Act of 1979".

California Code of Regulations Title 20, Chapter 2. Subchapter 4,Article 1.-Energy Building Regulations.

Building energy efficiency standards are specified.

California Administrative Code Title 20, Chapter 2, Subchapter 4: Energy Conservation, Article 4: Appliance Efficiency Standards.

Appliance efficiency regulations for refrigerators, freezers, room air conditioners, central air conditioners, gas space heaters, water heaters, plumbing fittings, fluorescent lamp ballasts and luminaries, gas cooking appliances, and gas pool heaters are specified.

Proposed Amendments to Energy Efficiency Standards for Nonresidential Buildings, and Hotels/Motels;and Provision Applicable to All Residential and Nonresidential Buildings, California Code of Regulations Title 24, Part 2, Chapter 2-53.

Amendments Affect Title 24 California Code of Regulations Chapter 2-53.

"Express terms of proposed amendments to the energy efficiency standards for low-rise residential buildings including additions and alterations..."are specified.

What is Regulated?

Appliances, building envelope, warm air heating equipment and systems, ventilation equipment and systems, cooling equipment and systems, lighting, labels, programs, government leased owned facilities, transportation, and miscellaneous items.

USA - State of New York

Article 8 - State Lighting Efficiency Standards for Existing Public Buildings Act.

Article 11 - State Energy Conservation Construction Code Act.

Article 16 - Energy Efficient Devices.

Subchapter III - Improving Energy Efficiency,Part A - Energy Conservation Program for Consumer Products other than Automobiles.

What is Regulated?

Appliances, building envelope, warm air heating equipment and systems, ventilation equipment and systems, cooling equipment and systems, plumbing equipment and systems, lighting, electric motors. small energy using products, labelling, miscellaneous items, and programs.

Other Countries

The summaries are by no means the full extent of statutes and regulations in other countries, but are brief descriptions extracted from the Ontario Ministry of Energy's *"International Review of Regulations and Programs in Energy Conservation"* publication.

Belgium - What is regulated?

Requirements for insulation in residential buildings, water heaters and oil space heaters, all space and water heaters must be labelled to show performance efficiency. Taxes on vehicles are proportional to weight.

Denmark - What is regulated?

Appliance efficiency, heating equipment, building thermal insulation, residential energy audits on houses built before 1989, minimum efficiencies for space heating equipment and control devices are regulated for oil- and gas-fired systems only.

Finland - What is regulated?

Insulation levels, residential thermostats "dead space".

France - What is regulated?

Appliance labelling showing annual energy usage, furnace efficiencies.

Germany - What is regulated?

Insulation, thermal properties of buildings, labels on electrical appliance and water heater showing efficiency. The utilities are required by legislation to use energy efficiency programs such as demand-side management (i.e. peak cutting, etc).

Italy - What is regulated?

Legge 30 Aprile 1976, N.373 sets guidelines for allowable energy use (it covers thermal loss coefficients, room temperatures, and heating systems (i.e. ventilation must recover 50 per cent of exhaust heat)).

Regulations state that large industries must hire energy managers and report their energy use.

The Netherlands - What is regulated?

Structural insulation.

Norway - What is regulated?

Structural insulation (dependent on indoor temperatures).

Sweden - What is regulated?

Energy performance standards must be met; ventilation must recover 50 per cent of exhausted heat; electric space heating equipment is regulated. Vehicles are taxed according to weight. The report indicates even though there is greater tax on heavier cars, the trend is to purchase the heavier units while technological advances have reduced fuel consumption. Road tolls are charged in the city, the money raised goes to public transit.

Switzerland - What is regulated?

Structural insulation, water and air heaters, ventilation systems are regulated. Annual energy use standards must be met. Electricity meters have to be installed for all buildings (i.e. apartments). Household appliance efficiency standards are regulated.

The United Kingdom - What is regulated?

Structural insulation is regulated. Hot water and warm air ducts must be insulated. Space heating equipment and control devices (i.e. boilers) must be equipped with an outside temperature monitoring device and have a timing device to shut off equipment when heat is not required; as well as optimizing of the different controls for proper sequencing.

Under the Electricity Act, 1989, utilities are required to promote efficiency.

Australia - What is regulated?

Building envelope (i.e. insulation) is regulated.

Japan - What is regulated?

Appliance efficiency: there must be labels on appliances to indicate energy use and efficiency. Manufactured products (cars, machinery, air conditioners, etc) and imported goods have to meet specific energy efficiency standards.

Energy management used in industry: if an industrial site uses more that 3 million litres of fuel or more that 12 GW.h per year, the site is designated as an energy management factory. Energy managers must be hired to monitor and record energy use. The energy use patterns are submitted for review by the Ministry of International Trade and Industry (MITI). The energy managers must be graduates of MITI. If MITI is not satisfied, an energy audit is ordered, structural and procedural changes can be ordered.

Appendix IV

References

A) Author:

David Whitfield , R.E.T.
Alberta Department of Energy

B) Resource Persons:

Rob MacIntosh
Alberta Environment Network

Jerry Lack
Alberta Environment

Larry Charach
Alberta Department of Energy

Jim Swiss
Canadian Petroleum Association

C. Organizations:

CANADA

Mike Barry
Ministry of Energy
Mines & Petroleum Resources
Room 421 - 617 Government Street
Victoria, B.C.
V8V 1X4
Telephone: 604-356-9797

Ed Grezik
Ministry of Energy
56 Wellesly Street
14th Floor
Toronto, Ontario
N7A 2B7
Telephone: 416-327-1492

Ron Pritchard
Manitoba Energy and Mines
55 - 303 Graham Avenue
Winnipeg, Manitoba
R3C 4E3
Telephone: 204-945-2671

Pierre Markon, Ing.
Bureau de l'Efficacite Energetique
425, Avenue Viger Ouest
Bureau 600
Monteal, Quebec
H2Z 1W9
Telephone: 514-873-5463

UNITED STATES

Stuart Brooks
Program Manager
State of Alaska
Office of Energy Programs
Suite 403, 949 E. 36th Avenue
Anchorage, Alaska
U.S.A 99508-4302
Telephone: 907-273-9441

Stephen Aheam
Energy Analyst
Arizona Department of Commerce
Arizona Energy Office
Suite 1200, 3800 N. Central
Phoenix, AZ
U.S.A. 85012
Telephone: 602-280-1420

Valerie Hall
California Energy Commission
Conservation Division
New Building & Appliance Eff. Offices
1516 - 9th Street, MS-25
Sacramento, Ca.
U.S.A. 95814
Telephone: 916-324-3383

Ann Stanton
Office of the Governor
State Energy Office
The Capital Building
Tallahassee, Florida
U.S.A. 32399-0001
Telephone: 904-487-1824

Randy Martin
Iowa Department of Natural Resources
Wallace State Office Building
East 9th & Grand Avenue
Des Moines, Iowa
U.S.A. 50319-0034
Telephone: 515-281-5145

Brian Costelli
Energy Office
2nd Floor
116 Pine Street
Harrisburg, Pennslyvania
U.S.A. 17101-1227
Telephone: 717-783-9981

Phil Ledeko
New York State Energy Office
Empire State Plaza
Albany, New York
U.S.A. 12223
Telephone: 518-473-4937

Jim Mapp, Ph.D.
Department of Energy and Intergovernmental Relations
6th floor, 101 S. Webster Street
P.O. Box 7868
Madison, Wisconson
U.S.A. 7868

Appendix V

Energy Efficiency Legislation
Terms of Reference

Objective:

Compile a listing of existing and proposed legislation in Alberta and other jurisdictions which address the issue of efficient use of energy.

Proposed Methodology:

Obtain outlines of existing legislation for Alberta and other areas which contain elements to promote the wise use of energy. Gather information from other countries if possible.

Scope:

Legislation listed will include both general statements and specific requirements such as the use of appliance efficiency standards. Items listed will be limited to those that make direct reference to increased energy efficiency.

Anticipated Output:

- an approximately six-page report listing the legislation identified and a brief description of each
- a matrix or appropriate listing format indicating which jurisdictions have implemented which legislation elements
- a listing of existing Alberta legislation that encourage energy efficiency
- the detail information obtained regarding programs to be retained in a reference library

Coordinator:

Les Sladen (Alberta Department of Energy)

Resource People:

Rob MacIntosh (Alberta Environmental Network)
Jerry Lack (Alberta Environment)
Larry Charach (Alberta Department of Energy)
Doug Bruchet (Canadian Petroleum Association)

Clean Air Strategy for Alberta

INVENTORY OF TRANSPORTATION INCENTIVES

Prepared by:
Alberta Department of Energy
Energy Efficiency Branch

May 1991

INVENTORY OF TRANSPORTATION INITIATIVES

TABLE OF CONTENTS

	Page
Table of Contents	i
Executive Summary	ii
Objectives	1
Methodology	1
Programs Table	1
Discussion	2
Conclusion	3

Appendix I - Programs Table

Appendix II - Program Descriptions

Appendix III - References

Appendix IV - Terms of Reference

EXECUTIVE SUMMARY

The objective of this inventory of transportation initiatives was to summarize existing and proposed programs in Alberta and other jurisdictions which address transportation emission reduction. This inventory was compiled at the request of the Clean Air Strategy for Alberta.

Information on these programs was collected and summarized in the table in Appendix I. Details on each program are summarized in Appendix II, in the same order as they are listed in Appendix I. The programs cover a broad range from information and general awareness, to training, audits, research, development, demonstrations, experimenting with telecommuting, supporting alternative fuels and doing emissions testing. Many of the programs are evolving to respond to the changing environmental issues.

Appendix III lists the names and addresses of organizations which can provide information on the programs listed in this inventory. Appendix IV is the terms of reference for this inventory.

More information is available from the Alberta Department of Energy, Energy Efficiency Branch.

Objective:

The objective of this inventory is to compile a listing of existing and proposed programs in Alberta and other jurisdictions which address the issue of emission reductions relative to transportation.

Methodology:

Federal and provincial governments were contacted to identify their existing and proposed programs that encourage reduced emissions.

The United States federal and some state governments were contacted to identify their existing and proposed programs.

Details on these programs were compiled into one listing as summarized in Table 1. (Appendix I)

Program Table:

The Table in Appendix I gives an indication of the types of programs which address emission reduction in transportation in the jurisdictions shown. Provinces not listed did not indicate the existence of any programs. In the United States, California and New York are considered the leaders in this area and have been included for that reason. As some information was available for some other states, it was included as well.

The level of activity indicated by an "x" in the table varies from one jurisdiction to another. The "x" only signifies that some type of program exists in the indicated category. An effort was made to confirm specific details relative to each program identified. In some cases, however, only telephone or condensed overviews were provided. This reduced the ability to confirm and evaluate all specifics.

Discussion:

The reasons or benefits for the programs described in this inventory can generally be classified as follows:

- Environmental Benefits: for example, gas volatility programs can reduce emissions from gasoline while transit funding can reduce pollution from automobile use (as well as traffic congestion).

- Security of Supply of Energy: for example, fuel economy standards, mechanic training for fuel efficiency, fuel-efficient vehicle purchase and alternative fuel vehicle purchases help reduce vulnerability to interruptions in supply by reducing the amount of fuel needed.

- Economic Benefits: for example, transportation energy audits, driver training and good maintenance practices can result in financial savings by reducing the amount of fuel needed.

In many cases, a combination of benefits is obtained from a particular program.

The types of programs described in this inventory may fit into more than one of the following categories:

- information and general awareness programs, including printed information, seminars, videos, information services, publicity campaigns, and fuel efficiency contests

- training programs, including on-the-road driver training and incentives, mechanic training on emission systems, and workshops

- transportation energy audits, energy management advice and programs

- research, development and demonstrations of new techniques

- transit infrastructure development

- implementation of fuel-saving measures such as flexible work schedules, telecommuting, teleconferencing, ride sharing and signal light timing optimization

- implementation of policies to purchase fuel efficient vehicles, or reduces the number of vehicles

- programs for alternative vehicle fuels including natural gas, propane, methanol, ethanol, hydrogen, electricity, and fuel cells including research and development, grant programs and tax relief

- exhaust emission testing, and gasoline volatility programs

- studies, and policy, development work at the provincial, state and federal levels in Canada and the United States, to develop programs or legislative measures.

Conclusion:

To reduce transportation emissions, it was found that various approaches were being used in various jurisdictions, and even within one jurisdiction. The information provided suggested that the approaches that are most successful depend on the particular circumstances in any given jurisdiction. Also, an approach which is successful with one target group may not be successful with another. For example, even if new car fuel economy is improved, someone who has no car or begins to telecommute is also helping significantly to reduce transportation emissions. This suggests that the most appropriate strategy may well be to consider a variety of approaches rather than a single solution. In any case, numerous good programs were found which may have application to augment existing Alberta transportation activities to reduce emissions.

Further Information/Follow-Up:

For further information on energy efficiency activities and programs, contact the Alberta Department of Energy, Energy Efficiency Branch at 7th floor, 9945 - 108 Street, Edmonton, Alberta, T5K 2G6 (403-427-5200).

APPENDIX I

Table 1. Inventory of Transportation Initiatives

Programs	Ont.	Alta.	B.C.	Man.	Nfld	P.E.I.	P.Q.	Can. Gov't	U.S. Gov't	N.Y.	Cal.	Tex.	Penn.
Seminars/Resource Mat'l	x	x						x	x			x	
Driver Training & Incentives		x											
Ridesharing	x					x				x			
Transportation Energy Audits		x											
Energy Management Advice				x	x	x	x						
Fuel Economy Challenge	x			x									
Publicity Campaigns		x	x										
Task Forces/Policy Development	x	x	x	x	x	x	x	x	x		x		
Municipal Seminars/Resource Mat'l	x							x					
Transit Funding & Promotion	x									x			
Fleet Reduction		x											
Gas Volatility Programs		x	x	x									
Tax Relief		x	x										
Fuel Economy Standards								x					
Flexible Hours Promotion										x			
Fuel Efficient Vehicle Purchase										x			
Signal Light Timing Optimizing										x			
Maintenance for Fuel Efficiency										x			
Telecommuting & Teleconferencing											x		
Natural Gas Research & Demonstrations	x	x						x					x
Natural Gas Information Initiatives								x					
Natural Gas Grants			x				x	x					
Propane Research & Demonstrations								x					
Propane Information Initiatives								x					
Propane Grants													
Methanol Research & Demonstrations		x						x					
Methanol Information Initiatives									x				
Methanol Grants													
Ethanol Research & Demonstrations								x					
Ethanol Grants and Loans				x					x				
Hydrogen Research		x	x					x		x			
Electric & Fuel Cell Research	x							x	x				
Engine Research									x				
Biomass Research									x				
Alternative Fuel Vehicle Purchases		x								x	x		
Alternative Fuels Demo Projects								x	x	x			
Energy Library Service									x				
Inquiry Service									x				
General Grants and Research									x		x		
Non-fuel Transport Promotion		x											
Exhaust Testing Programs											x		

x = active program

Appendix II

Program Descriptions:

Below are some details on the programs listed in the order in which they appear in Table 1:

Seminars and Resource Material

The Ontario Trucksave/Drivesave Program includes fleet managers' seminars, videos, vehicle specifying material, a stop-idling campaign, the pro-trucker fuel economy challenge and alternative transportation fuels information.

Enersearch is a multi-year program which provides assistance to the private sector for the research, development, testing, and initial demonstration of innovative energy-related technologies in Ontario. The program includes an "Innovations in Natural Gas Technologies Seminar" which provides up-to-date information on technology development. It is also sponsored by the Ontario Natural Gas Association and the Canadian Gas Research Institute.

Alberta offers fuel economy seminars on the topic of transportation energy management. Alberta has the *Top Secrets for Fuel Economy* kit which includes four brochures plus a Fuel Economy Calculator. Alberta also offers the Energy $aver booklet series for commercial and industrial transportation which consists of five booklets on the fundamentals of vehicle fuel economy: *Management for Fuel Economy, Vehicle Selection, Maintenance, Operating Practices,* and *Driving Skills*. Seven posters on fuel economy are also available.

The Canadian federal "Driver Outreach Program" encourages better fuel economy from everyday motorists, by the transfer of energy efficiency information through seminars and the dissemination of documentation.

The Windsor Workshop on Alternative Fuels is an annual forum of experts in the field, usually held in Windsor, Ontario, partly sponsored by Energy, Mines and Resources Canada and the United States Department of Energy.

The U.S. government publishes the "Federal Energy Guidelines" on a weekly basis. It is a set of loose-leaf publications dealing primarily with United States federal energy activities and general data regarding energy policy. The United States Conservation and Renewable Energy Inquiry and Referral Service provides information on the full spectrum of renewable energy technologies and energy conservation. The United States *Gas Mileage Guide* is a booklet that is helpful in selecting a vehicle based on fuel efficiency.

Texas Energy Efficient Fleet Management is a fact sheet covering car, truck and heavy equipment fuel efficiency in business operations.

Driver Training and Incentives

Alberta has a Driver Energy Conservation Awareness Training (DECAT) program. Driving instruction for fuel economy is provided for commercial drivers using a van equipped with a vacuum gauge and fuel computer.

The City of Edmonton has initiated a fuel savings incentive program to help improve fuel economy in fleet vehicles.

Ride Sharing

Ontario provides "Share-a-Ride" information on ride sharing.

Prince Edward Island "EnerPool Vans" demonstrate the potential for energy conservation in ride sharing transportation. There are currently four vans in operation.

The New York Transportation Systems Management Program provides direct assistance to companies, employers, and regional organizations to establish local transportation programs, particularly for commuters. This New York program is intended to encourage car pooling by issuing special licence plates to car poolers and by building special car pool lanes on new roads. The response has been minimal as consumers resist car pooling and the program is essentially dormant. Grants are available to groups with project proposals to increase the use of public transportation. Activities include providing employer-based ride sharing and transit-use campaigns, promoting ride sharing and public and private transit use directly to commuters, promoting staggered or flexible work-hour programs, publishing a commuter register and providing van pool and car pool matching services and public transit assistance.

Transportation Energy Audits

Alberta offers a computerized energy transportation energy audit which is available from the Energy Efficiency Branch.

Each of Alberta's Energy Bus vehicles is equipped with computers and various monitoring devices needed for vehicle checks. The computer analysis can provide information on potential savings through vehicle selection, vehicle maintenance, vehicle routing, and driver training. There is no charge for this service.

Energy Management Advice

An information officer from the Manitoba Pro-Trucker Program provides impartial advice on fuel-efficient operation to the trucking industry, including vehicle specification, maintenance and driving techniques. The program is directed by an advisory council of industry representatives and is targeted at owners/operators, small fleet owners, and all commercial drivers. Similar Pro-Trucker programs are offered by Newfoundland, Quebec, New Brunswick and Prince Edward Island. Pro-Trucker is sponsored by Energy, Mines and Resources Canada and the participating provinces and industry. There is no charge for this service.

Fuel Economy Challenge

An annual fuel economy challenge is a component of the Manitoba Pro-Trucker and Ontario Trucksave programs described earlier. Each year a competition is held to determine which trucker can travel the specified route using the least amount of fuel.

Publicity Campaigns

Alberta has initiated an "Energywise" program emphasizing fuel efficiency in the provincial public service as well as activities targeted to large employers and commercial fleet operators. The specific elements of the program include a public awareness campaign featuring radio advertising, brochures, poster and telephone enquiry line; appointment of energy efficiency coordinators in each provincial department; the promotion of ride sharing in the public service; the encouragement of improved fuel efficiency in government vehicles, an information program to encourage large employers to promote fuel-efficiency measures; an information program to encourage commercial fleet operators to improve vehicle efficiency and promotion of a computerized routing program for commercial fleets.

British Columbia has a "Go Green" campaign. The objective is to raise public awareness of the environmental and economic reasons for commuting by car pool or transit.

Task Forces/Policy Development

Ontario has a Sustainable Development Task Force. Other provinces have similar task forces.

Provincial premiers participate in the "Premiers' Round Table on Environment and Economy". Proposals are being developed for reduction of atmospheric emissions by more efficient use of gasoline and diesel, use of alternative fuels, development of technology for alternatives, increased use of public transit, and improved emissions standards enforcement.

Provinces are also developing responses to the federal Green Plan. Several measures are transportation-related.

Ontario is also providing input to the Ontario-Quebec Task Force on High-Speed rail.

B.C.'s Inter-Ministry Task Force on Alternate Fuels plans to play a leading role in the fight against atmospheric pollution and the preservation of a sustainable healthy environment. The task force will test alternative fuels. The task force will also act as a clearing house for information.

The U.S. government has produced a number of studies on transportation and emissions reduction.

Two bills on telecommuting have passed both houses of the California legislature (Assembly Bill 2962 and 2963). The South Coast Air Quality Management District now includes telecommuting as an acceptable trip-reduction strategy. The Southern California Association of Governments (SCAG) has also established an ordinance qualifying telecommuting as a trip-mitigation option. It projects that 80 per cent of the work force will participate in alternative work projects including flextime, a four day, 40-hour work week, and a nine day, 80-hour work schedule every two weeks.

Municipal Seminars/Resource Material

Ontario's Municipal Energy and Efficiency program offers a Fleet Management Seminar held with the Ontario Good Roads Association.

The federal Regional Transportation Energy Program encourages municipalities to reduce their transportation fuel consumption through seminars to municipal fleet managers and drivers, and through the dissemination of publications. One example is the *Guidebook on Transportation Energy Management* by the Federation of Canadian Municipalities which was funded by Energy, Mines and Resources.

Transit Funding and Promotion

Ontario is enhancing rapid transit in the greater Toronto region with a $5 billion infrastructure investment.

New York's Transportation Systems Management Program promotes public transit. Please see under Ride sharing.

Fleet Reduction

The City of Edmonton, has implemented a plan to reduce the total number of vehicles and the distance travelled to an optimal level.

Gasoline Volatility Programs

Refiners in Alberta have agreed to a summer gasoline vapour pressure limit of 10.5 pounds per square inch (psi) in order to reduce hydrocarbon emissions. British Columbia is implementing a voluntary project with Canadian West Petroleum Association to implement stage 1 of volatile organic compound (VOC) vapour emission recovery. Manitoba is relying on distributors and retailers to voluntarily comply with lower vapour pressure gasoline levels.

Tax Relief

Natural gas used as a vehicle fuel is not taxed by British Columbia or Alberta. There is no provincial sales tax on conversion kits in British Columbia. There is no road tax on ethanol in Alberta.

Fuel Economy Standards

The purpose of the Canadian Federal Motor Vehicle Fuel Consumption Program (MVFCP) is to promote actions and policies to improve the fuel consumption of motor vehicles, with emphasis on new vehicles. The main feature of the program since its inception in the late 1970s has been Corporate Average Fuel Consumption (CAFC) standards for new automobiles. Information for consumers is also distributed (*Fuel Consumption Guide, Car Economy Book).*

Flexible Hours Promotion

New York promotes staggered or flexible work-hour programs as part of its Transportation Systems Management Program.

Fuel-Efficient Vehicle Purchase

New York has a policy in effect which requires offices of the state government to purchase fuel-efficient vehicles. Offices have had difficulty in meeting the standard.

Signal Light Timing Optimization

New York has a Signal Timing Optimization Program (STOP). Training, technical assistance and financial assistance for re-timing and synchronization of traffic signals is provided. Financial assistance is awarded to program participants to perform all phases of re-timing activities including data collection, timing installation and evaluation. This program is operated by the Bureau of Industry, Commerce and Transportation in cooperation with Rensselaer Polytechnic Institute.

Maintenance for Fuel Efficiency

New York has an Automotive Technician Training Program. This program provides technical training in the diagnosis and repair of vehicle emissions problems, computer engine control, fuel injection, and electronics systems. Tuition subsidies are provided. This program is operated by the Bureau of Industry, Commerce and Transportation in cooperation with the state Department of Motor Vehicles.

Telecommuting and Teleconferencing

Various projects in California are under way to reduce commuting (such as a project to encourage state employees to work at home once or twice a week) and to encourage car and van pooling. Much of the program is driven by environmental concerns, particularly with regard to emissions of smog-causing particulate matter.

Major experiments have been conducted by a number of companies such as Alberta Blue Cross and Blue Shield. In the Blue Cross/Blue Shield experiment, data entry operators were allowed to process insurance claim forms from home terminals connected to mainframe computers at headquarters.

Other companies that have successfully instituted telecommuting programs include American Express, AT&T, IBM, J.C. Penney, Mellon Bank and Pacific Bell. The California Energy Commission notes also that previous experience with telecommuting in the private sector has shown significant and lasting increases in the productivity of telecommuters, decreased rates of turnover, space and energy savings and cost benefits. The California Energy Commission reports that commuting accounts for almost half of the automobile transportation energy use in California. The state completed a two-year telecommuting project in the summer of 1990.

Teleconferencing is available commercially and is growing in popularity.

Natural Gas Research and Demonstrations

The Canadian federal Natural Gas for Vehicles (NGV) Technical Program provides funds for research and development with field trials. Toronto and Mississauga have been provided with three "concept" natural gas buses for testing.

Through the NGV Market Development/Demonstration Program the Canadian federal government will supply up to 50 per cent of the costs of specific development and demonstration projects designed to create new NGV markets.

Conversion costs to natural gas for Edmonton's bus fleet have been determined. A Toronto trial in which 30 buses have been converted to natural gas operation is being monitored and the outcome will influence Edmonton's decisions. Calgary is also considering a pilot conversion of some city buses.

General Motors sponsors a student design competition which features natural gas as an automotive fuel.

The state of Pennsylvania provides financial assistance to encourage the use of compressed natural gas in vehicles.

Natural Gas Information Initiatives

Through its NGV Marketing Program, the Canadian federal government contributes to the salary costs of an NGV marketing executive and to advertising and promotion costs.

Natural Gas Grants

The British Columbia government has a program to assist with conversion of a vehicle to natural gas. Conversion cost to the user is as low as $1,399. Tanks can be leased for $7.00 a month. Financing with a down payment of $399 is possible. British Columbia Gas also provides low-cost financing, and it leases the storage cylinders.

A Natural Gas Home Refuelling Appliance is built and sold by Fuelmaker Corp. of Vancouver and is available through gas utilities in B.C., Alberta, and Ontario. Lack of availability of conversion equipment has resulted in some delays for potential customers.

Quebec has incentives for adaptation of vehicles to natural gas. Nine hundred dollars could be granted to vehicle owners who wish to use compressed natural gas as fuel.

More than $28 million in Market Development Incentive Payments (MDIP) funds are available to expand the market for natural gas and methanol as transportation fuels in Canada. MDIP funds will be directed to initiatives which can, over the next five years, contribute to a viable, self-sustaining natural gas vehicle (NGV) industry in Canada and achieve an initial market penetration of methanol as a vehicle fuel.

The Canadian federal Natural Gas for Vehicles Program offers a $500 grant to convert a vehicle to use natural gas. The federal Natural Gas Fuelling Station Program offers a $50,000 grant for construction of a fuelling station. The federal Vehicle Refuelling Appliance (VRA) Program provides a $1,000 grant for a VRA. The federal Commercial Compression Program provides 25 per cent of capital cost of a commercial compressor up to $50,000.

Propane Research and Demonstrations

The Canadian federal Auto Propane Market Development/Demonstration Program supports market demonstration projects. The federal Auto Propane Technical Program supports research and development and field trials.

Propane Information Initiatives

The Canadian federal Auto Propane Marketing Program provides a contribution to the salary costs of a propane marketing executive.

Propane Grants

No propane conversion grants were found.

Methanol Research and Demonstrations

The MDIP agreement to expand markets for natural gas and methanol provides funds for a technology development program for methanol use in vehicles. The federal Methanol Technical Program supports research and development, field trials and technical demonstrations primarily for large engine development.

The federal Methanol Market Development/Demonstration Program includes a light duty flexible fuel vehicle and a methanol powered bus demonstration.

Medicine Hat now operates eight methanol-powered city transit buses.

Methanol Information Initiatives

Please see "Inquiry Service" and "Energy Library Service" below.

Methanol Grants

No methanol conversion grants were found.

Ethanol Research and Demonstrations

The federal Ethanol Technical Program includes a bus demonstration project.

Ethanol Grants and Loans

Manitoba provides a tax forgiveness of 3.5 cents per litre for blends of 10 per cent alcohol in gasoline sold in the Province of Manitoba. The alcohol must be derived from biomass materials, denatured and contain not more than one per cent water. Minnedosa, Manitoba, is the only location in Canada where fuel ethanol is produced from biomass.

The U.S. Office of Alcohol Fuels implements the Energy Security Act's loan guarantee program, which is designed in part to encourage the construction of alcohol fuel production facilities by the private sector.

Hydrogen Research

The Alberta Hydrogen Research Program administers research and development projects funded by the Alberta/Canada Energy Resources Research Fund and the private sector.

British Columbia Science and Technology Fund supports a "Hydrogen Fuel for BC Transit Bus" project. They are developing and testing a fuel cell in a transit bus. CANMET, the main research and technology development area of the Federal Department of Energy, Mines and Resources, is also providing funding.

The federal Hydrogen Technical Program supports research and development projects.

Syracuse University's Department of Chemical Engineering and Materials Science will conduct research on the safest and most efficient methods to transport hydrogen, in an attempt to increase its potential use as an alternative fuel and energy source.

Electric and Fuel Cell Research

Two projects in Ontario's Enersearch program are Aluminum-Air Fuel Research done under contract with Alupower Canada Ltd. and a Hydrogen Production System done under contract with Electrolyser Corporation Limited.

The federal Electrical Vehicles Technical Program is providing funding for a research and development effort on a battery with high power and energy density.

The U.S. Department of Energy's Electric and Hybrid Vehicles (EHV) Program is conducting research, development, testing and evaluation activities to encourage the use of electricity and alternative fuels for transportation.

Engine Research

The U.S. Department of Energy's Heat Engine Propulsion Division is conducting research, development, testing and evaluation activities to develop heat engine options capable of high fuel economy, low exhaust emission levels and the ability to burn any liquid or gaseous fuel. Work has concentrated on high temperature gas turbines, Stirling engines, diesel technology with waste heat utilization, alternative fuels and ceramic and composite materials.

Biomass Research

The U.S. Renewable Energy Technologies program manages the research, development and proof-of-concept activities of biomass energy technology. Emphasis is placed on development of renewable technology with potential to increase significantly the nation's supply of fuel, heat, and electricity.

Alternative Fuel Vehicle Purchases

Twelve per cent of the City of Edmonton's light trucks and passenger fleet vehicles have been converted to propane. High-use vehicles are converted first.

The city of New York is buying vehicles for fleets that run on alternative fuels like natural gas and methanol. Purchases this year represent more than 10 per cent of car and truck acquisitions, a percentage that is expected to rise significantly.

The state of California has ordered some 500 alteratively-powered vehicles for its fleet.

Alternative Fuels Demonstration Projects

The federal Transportation Energy Research Program engages in long-term research on alternative transportation fuels technology, such as a high-speed valve for injection of natural gas; a high-strength composite tank for natural gas storage; handling, storage and direct injection of liquid natural gas; carbon dioxide tolerant fuel cells; dimethyl ether as combustion enhancer for methanol engines and an injector-igniter for methanol engines.

The programs under the United States Alternative Motor Fuels Act of 1988 were designed to encourage the development and widespread use of methanol, ethanol, and natural gas as transportation fuels by consumers and encourage the production of methanol, ethanol, and natural gas-powered motor vehicles. Major alternative fuels programs include a federal light-duty vehicle demonstration project, a truck commercial application project, an alternative fuels bus testing project, and studies on alternative fuels.

The New York Energy Research and Development Authority plans to implement a demonstration of alternative fuels such as methanol and compressed natural gas on a trial basis.

Energy Library Service

The United States Energy Library provides a wide variety of bibliographic and reference services. The library is a major repository of energy-related information.

Inquiry Service

Please see Oak Ridge National Laboratory under General Grants and Research.

General Grants and Research

The United States Energy-Related Inventions and Innovation Program identifies, evaluates, and supports promising energy-related inventions and innovative technology.

The Oak Ridge National Laboratory performs research supported by the Department of Energy on a broad range of energy-related problems and provides technical information and assistance on energy research for state and local governments and the private sector.

The United States Office of Technology Sharing serves as the national research and development centre for transportation systems design and for evaluative studies on various kinds of transportation programs.

California sponsors research work on alternative fuels such as methanol, natural gas, and electricity for motorized transport.

Non-fuel Transport Promotion

"Bike Week" has been promoted in Edmonton in May.

Exhaust Testing Program

California and several other states have vehicle exhaust emission testing programs. Similar programs are now being considered in Canada.

Appendix III

References

A) Author:

Doug MacLean,
Alberta Department of Energy

B) Resource People:

Tooker Gomberg
Eco City Society

Charles Lendzion
Alberta Transportation

Mark Brostrom
City of Edmonton

Jerry Lack
Alberta Environment

Rob MacIntosh
Alberta Environment Network

Doug Bruchet
Canadian Petroleum Association

C) Organizations:

ONTARIO

Ministry of Transportation
Transportation Technology Branch
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8
Telephone: 416-248-7191
416-235-5017

and

Ministry of Energy
56 Wellesley Street West
Toronto, Ontario
M7A 2B7
Telephone: 416-327-1489

ALBERTA

City of Edmonton
12404 - 107 Street
P.O. Box 2359
Edmonton, Alberta
T5J 2R7
Telephone: 403-496-6466

Alberta Department of Energy
Energy Efficiency Branch
7th Floor, 9945 - 108 Street
Edmonton, Alberta
T5K 2G6
Telephone: 403-427-5200

BRITISH COLUMBIA

Province of British Columbia
Ministry of Energy Mines and Petroleum Resources
Energy Management Branch
Room 418
617 Government Street
Victoria, British Columbia
V8V 1X4
Telephone: 604-356-0608

MANITOBA

Manitoba Energy and Mines
555 - 330 Graham Avenue
Winnipeg, Manitoba
R3C 4E3
Telephone: 204-945-3674

NEWFOUNDLAND

Department of Energy
P.O. Box 4750
St. John's, Newfoundland
A1C 5T7
Telephone: 709-576-5899

PRINCE EDWARD ISLAND

Department of Energy and Forestry
P.O. Box 2000
Charlottetown, Prince Edward Island
C1A 7N8
Telephone: 902-368-5010

QUEBEC

Ministre de l'Energie et des Ressources
5700 4 ieme Avenue ouest
Local A-412
Charlesbourg, Quebec
G1H 6R1
Telephone: 418-643-8480

CANADA

Efficiency and Alternative
Energy Branch
Energy Mines and Resources Canada
Room 1586, 15th Floor
580 Booth Street
Ottawa, Ontario
K1A 0E4
Telephone: 613-995-0081

Canada Service Bureau Program
Supply and Services Canada
Ottawa, Ontario
K1A 0S5
Telephone: 819-956-3341

Interprovincial Advisory Committee on Energy, Conservation and Renewable Energy Subcommittee
c/o Energy Efficiency Branch
7th Floor, 9945 - 108 Street
Edmonton, Alberta
T4K 2G6
Telephone: 403-427-5200

Canadian Council of Ministers of the Environment
Deputy Minister's Committee
3rd floor, Building 30
139 Tuxedo Avenue
Winnipeg, Manitoba
R3N 0H6
Telephone: 204-948-2133

UNITED STATES

Commerce Clearing House Inc.
4025 West Peterson Avenue
Chicago, Illinois
60646
U.S.A.
Telephone: 312-940-4600

Conservation Update
P.O. Box 3249
Frankfort, Kentucky
40603-3249
U.S.A.
Telephone: 502-564-7192

Government Institutes, Inc.
966 Hungerford Drive, #24
Rockville, MD (Washington, D.C.)
20850
U.S.A.
Telephone: 301-251-9250

Heat Engine Propulsion Division
Office of Transportation Systems
U.S. Department of Energy
Forrestal Building CE-151
1000 Independence Avenue S.W.
Washington, D.C.
20585
U.S.A.
Telephone: 202-586-8027

National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA
22161
U.S.A.
Telephone: 804-487-4600

Office of Technology Sharing
Department of Transportation
Kendall Square
Cambridge, Massachusetts
02142
U.S.A.
Telephone: 617-494-2486

United States Department of Energy
Energy Information Administration
National Energy Information Centre
U.S. Department of Energy
Washington, D.C.
20585
U.S.A.
Telephone: 202-586-8800

United States Department of Energy
Office of Conservation and Renewable Energy
Office of Transportation Technology
1000 Independence Avenue S.W.
Washington, D.C.
20585
U.S.A.
Telephone: 202-586-8027

United States Department of Transport
National Highway Traffic Safety Administration
400 Seventh Street S.W.
Washington, D.C.
20590
U.S.A.
Telephone: 202-366-0846

NEW YORK

New York State Energy Office
2 Rockefeller Plaza
Albany, New York
12223
U.S.A.
Telephone: 518-473-0834

CALIFORNIA

California Energy Commission
1516 Ninth Street
Sacramento, California
U.S.A.
95814-5512
Telephone: 916-324-3014

State of California
Air Resources Board
1102 Q Street
P.O. Box 2815
Sacramento, California
95812
U.S.A.
Telephone: 916-322-2990

TEXAS

Energy Resources
1700 North Congress Street
Stephen F. Austin Building
Austin, Texas
78701-1495
U.S.A.
Telephone: 512-463-5237

PENNSYLVANIA

Pennsylvania Energy Office
116 Pine Street
Harrisburg, Pennsylvania
17101
U.S.A.
Telephone: 717-783-9981

Appendix IV

Inventory of Transportation Initiatives Terms of Reference

Objective:

Compile a listing of existing and proposed programs in Alberta and other jurisdictions which address the issue of emission reductions relative to transportation.

Proposed Methodology:

a) Contact federal and other provincial governments to identify their existing and proposed programs that encourage reduced emissions or use of alternate modes of transportation.

b) Contact U.S. federal and some state governments to identify their existing and proposed programs.

c) Identify current Alberta initiatives that encourage reduced emissions from transportation.

d) Compile the different programs into one listing, indicating such items as the reason for the program, the expected results, the cost of the program, potential economic and/or environment savings, and peripheral benefits or problems.

Scope:

The scope of this evaluation is as follows:

- all transportation fuels and alternative activities which promote emission reductions should be included

- consider programs for all vehicular sectors, including individual automobiles, motorcycles, bicycles, buses to truck fleets and modal shifts.

Anticipated Output:

The output of this study should include:

- an approximately six-page report listing of existing and proposed transportation programs for Alberta and other jurisdictions. The list should include a brief description and related data for each.
- a descriptive matrix or appropriate listing format of proposed programs.
- the detailed information obtained regarding programs to be retained in a reference library.

Coordinator:

Les Sladen (Alberta Department of Energy)

Resource People:

Tooker Gomberg (Eco City Society)
Charles Lendzion (Alberta Transportation)
Ray Coutts (City of Edmonton)
Jerry Lack (Alberta Environment)
Rob MacIntosh (Alberta Environmental Network)
Doug Bruchet (Canadian Petroleum Association)
Doug MacLean (Alberta Department of Energy)

Clean Air Strategy for Alberta

COORDINATION OF SCIENCE AND TECHNOLOGY RELEVANT TO CLEAN AIR ISSUES

Prepared by:
Alberta Department of Energy
Environmental Affairs Branch

June 1991

For information on this report contact:

Marianne English
Alberta Department of Energy
Environmental Affairs Branch
7th floor, North Petroleum Plaza
9945 - 108 Street
Edmonton, Alberta
T5K 2C9
(403 427-5200

ACKNOWLEDGEMENTS

Thanks are extended to Dr. E. J. Wiggins (Alberta Oil Sands Technology and Research Authority), Mr. R. P. Angle and Mr. J. A. Jaferi (Alberta Department of Environment), Mr. R. C. MacKenzie (Alberta Department of Energy) and Mr. Tim Goos (Environment Canada) for their assistance in developing the questionnaire used in this project and also in surveying appropriate individuals. The results reported here were derived from responses from 60 individuals; without their cooperation this report would not have been possible. A draft of this report was reviewed by: Dr. P.E. Merilees, Mr. A.J. Malinauskas and Mr. Tim Goos of Environment Canada, Dr. David Brown of Energy, Mines and Resources Canada, Dr. R. S. Weaver, Mr. R.P. Angle and Mr. J.A. Jaferi of Alberta Department of Environment, Mr. D. C. Wharton, Mr. R. H. Mitchell, Mr. D.E. Macdonald and Mr. R.C. MacKenzie of Albert Department of Energy, Dr. E. J. Wiggins of the Alberta Oil Sands Technology and Research Authority, Dr. R. J. Fessenden of the Alberta Research Council, Dr. Erdal Yildirim of the Alberta Chamber of Resources and Canadian Occidental Petroleum Ltd., Dr. M.E. Moir of Esso Resources Canada Ltd. and Mr. L. M. Johnston of Edmonton Power. The suggestions and comments of the reviewers have been very helpful.

CONTENTS PAGE

EXECUTIVE SUMMARY 1

INTRODUCTION 2
Objective 2
Methodology 2

THE RESPONDENTS AND THEIR ACTIVITIES 2

COORDINATION OF SCIENCE AND TECHNOLOGY RELATED TO CLEAN AIR ISSUES 10

Some Existing Coordination Mechanisms 10
Panel on Energy Research and Development (PERD) 10
Canadian Reference Group (ETSAP) 11
Canadian Climate Program Board (CCPB) 11
Canadian Council of Ministers of the Environment (CCME) 12
CEPA Federal/Provincial Advisory Committee 12
Federal/Provincial Accords Committee on Environmental Sustainability 13
Western Accord on Environmental Cooperation 13
Technology and Research Advisory Committee (TRAC) 13
Natural Resources Coordinating Council (NRCC) 13
Program Committees 14

Other Existing Coordination Mechanisms 14

Discussion 15

CONCLUDING REMARKS 17

LIST OF TABLES:
Table 1: Questionnaire Respondents 3
Table 2: Activities, Capabilities, and Interests of Respondents 6 to 9
Table 3: Alberta Government Organizations Cited as Sources of Funding by the Respondents 3
Table 4: Some Coordinating Committees Cited by Respondents 9
Table 5: Information Exchange Mechanisms 18

EXECUTIVE SUMMARY

At the Issues and Options Workshop (Clean Air Strategy for Alberta initiative), participants suggested that research and development activities relevant to the Strategy need to be prioritized, coordinated and facilitated. Thus a questionnaire was developed and distributed to appropriate individuals in Canada to establish an inventory of science and technology activities related to clean air, and to identify existing coordination mechanisms for these activities.

Sixty completed questionnaires were received. Thus the results derived should be considered as examples of what exists and not a comprehensive listing of activities and coordination mechanisms.

The respondents listed a wide range of activities, capabilities and interests. These have been grouped under the headings:

- atmospheric chemistry, meteorology and processes;
- effects on health, animals and the environment;
- integration of issues and information;
- technology and management strategies;
- funding and managing research.

Clean air issues are of at least peripheral interest to many organizations and therefore many organizations fund research on these issues. Most respondents reported at least some funding from government sources. Almost half said that confidentiality and proprietary issues are important to them.

Three respondents suggest that indoor air quality should be included in the Clean Air Strategy and two wondered if health effects were being addressed adequately.

A number of committees (panels, boards, councils) have been identified and are described. Most are advisory in nature. Only three of the ones described appear to be primarily concerned with identifying and prioritizing research needs and coordinating and evaluating research. These three are:

- the Panel on Energy Research and Development (PERD);
- the Technical Committee of the Western and Northern Canada Acid Deposition and Long Range Transport of Air Pollutants Program; and
- The AOSTRA/ARC Policy and Program Committee.

However, PERD only deals with research activities funded by the federal government, the Technical Committee is being disbanded and the AOSTRA/ARC Policy and Program Committee only concerns itself with advanced in situ oil sands recovery research.

A key missing ingredient in the plethora of committees seems to be strategic direction. Perhaps by bringing together the stakeholders periodically, strategic directions can be established which can then be implemented through facilitation and cooperation among the funding agencies and researchers.

INTRODUCTION

The Clean Air Strategy for Alberta is a joint initiative of Alberta Department of Energy and Alberta Department of Environment. It is intended to encourage public discussions on air emissions resulting from the production and use of energy in Alberta. The process is guided by a 15 member Advisory Group which comprises representatives from environmental groups, local government, public health authorities, the native community, the energy, transportation, chemical and utilities industries, and provincial government departments. An Issues and Options Workshop, whose purpose was to examine key questions on the need for and the scope of actions to deal with greenhouse gas emissions, acid deposition and smog, was held in September 1990. Participants expressed the view that investing in research to better understand air quality is a fundamental component of any clean air strategy. However, participants recognized that there are limited dollars and suggested that research and development activities need to be prioritized, coordinated and facilitated by an independent body. As a result, the Advisory Group requested that an inventory of science and technology activities related to clean air be developed and that existing coordinating mechanisms for these activities be identified.

Objective

In response to this request a study was conducted that had the following objectives:

a) Identify activities and interests of organizations, both within and outside Alberta, that are active in clean air issues with respect to:
   - information services
   - monitoring
   - research
   - technology development.

b) Identify existing mechanisms for communicating amongst and for coordinating activities between these programs and organizations.

Methodology

A questionnaire was developed, and a list of about 100 persons to be surveyed was prepared. Each person was telephoned, the purpose of the questionnaire was discussed, and the person was asked to provide a completed questionnaire. Some who completed questionnaires were interviewed at length either in person or over the telephone. Terms of reference for some of the key committees that were cited as coordinating mechanisms were obtained from the appropriate authorities.

THE RESPONDENTS AND THEIR ACTIVITIES

Approximately 100 questionnaires were distributed and 60 completed ones received. A list of organizations that returned completed questionnaires is given in Table 1. (Some larger research organizations returned more than one.) The following charts show the distribution of

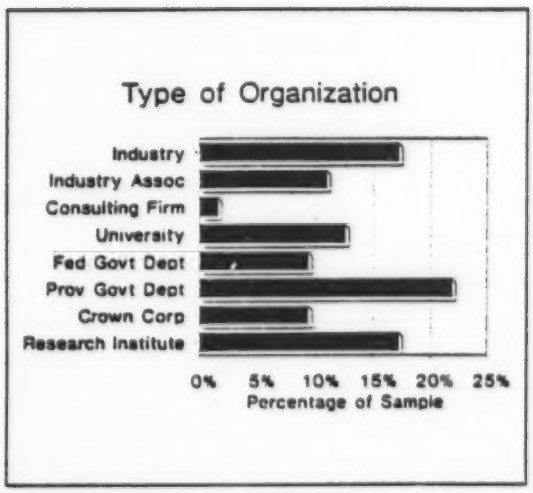
TABLE 1:
QUESTIONNAIRE RESPONDENTS

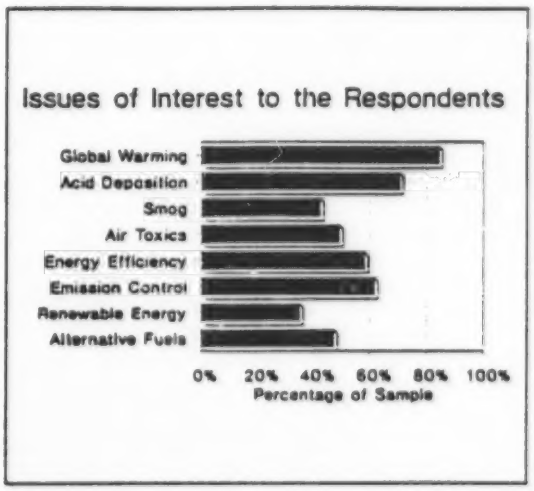
Organization	No. of Completed Questionnaires
Agriculture Canada (AC),	1
Alberta Agriculture (AA),	1
Alberta Chamber of Resources (ACR),	1
Alberta Department of Energy (A Energy),	1
Alberta Environment (A Environ),	3
Alberta Forestry, Lands and Wildlife (AFLW),	1
Alberta Oil Sands Technology and Research Authority (AOSTRA),	1
Alberta Research Council (ARC),	6
British Columbia Environment (BCE),	1
Canadian Chemical Producers Association (CCPA),	1
Canadian Energy Research Institute (CERI),	1
Canadian Manufacturers Association (CMA),	1
Canadian Petroleum Association (CPA),	1
Canadian Occidental Petroleum (COP),	1
Celanese Canada (CC),	1
Coal Association of Canada (CAC),	1
Edmonton Power (EP),	1
Energy, Mines and Resources Canada (EMR),	3
Energy Resources Conservation Board (ERCB),	1
Environment Canada (EC),	4
Esso Resources (Esso),	1
Friends of Environmental Education Society of Alberta (FEESA),	1
Government of the Northwest Territories (GNWT),	1
Independent Petroleum Association of Canada (IPAC),	1
International Cooling Towers Inc. (ICTI),	1
MacDonald Dettwiler (MD),	1
Manitoba Environment (ME),	1
National Research Council (NRC),	1
Ontario Ministry of the Environment (OME),	1
Prairie Farm Rehabilitation Administration (PFRA),	1
Saskatchewan Energy and Mines (SEM),	1
Saskatchewan Environment and Public Safety (SEPS),	1
Saskatchewan Research Council (SRC),	1
Shell Canada (Shell),	1
Small Explorers and Producers Association of Canada (SEPAC),	1
Suncor Incorporated (Suncor),	1
Syncrude Canada (Syncrude),	1
Union Carbide Linde Division (UCLD),	1
University of Alberta (U of A),	3
University of Calgary (U of C),	3
University of Guelph (U of G),	1
University of Victoria (U of V),	1
University of British Columbia (UBC),	1
Western Research (WR),	1

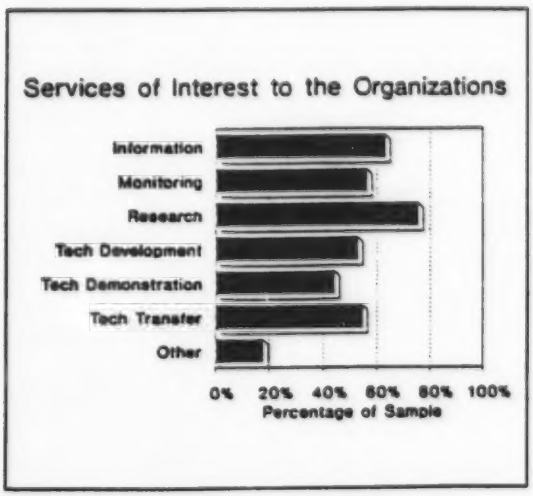
TABLE 3:
ALBERTA GOVERNMENT ORGANIZATIONS CITED AS SOURCES OF FUNDING BY THE RESPONDENTS

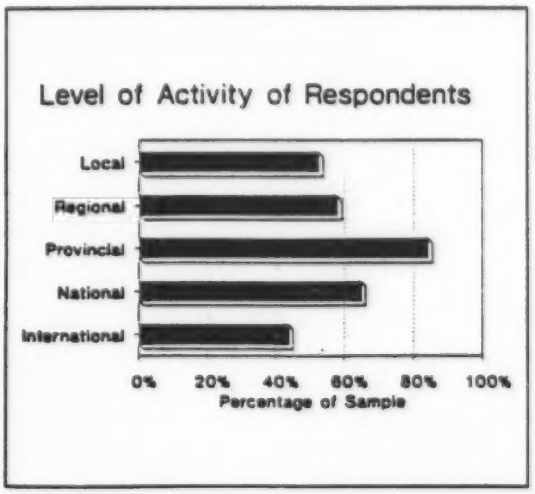
Alberta Agriculture
Alberta Department of Energy
Alberta Environment
Alberta Environmental Research Trust
Alberta Forestry Lands and Wildlife
Alberta Municipal Affairs
Alberta Occupational Health and Safety
Alberta Oil Sands Technology and Research Authority
Alberta Research Council
Alberta Technology Research and Telecommunications
Energy Resources Conservation Board

the respondents with respect to: type of organization; issues of interest to the organization; services of interest to the organization; and the level at which the organization is active. (Note that respondents were asked to check as many choices under each question as applicable, so that the percentages given in the charts should be interpreted as the percentage of the total number of respondents. Furthermore, the terms used to lable the varius choices were not defind and may not have been interpreted in the same way by all respondents.) Many organizations are interested in most of the issues and services and are active at most of the levels. Two-thirds of the respondents are situated within Alberta and one- third are from outside Alberta.







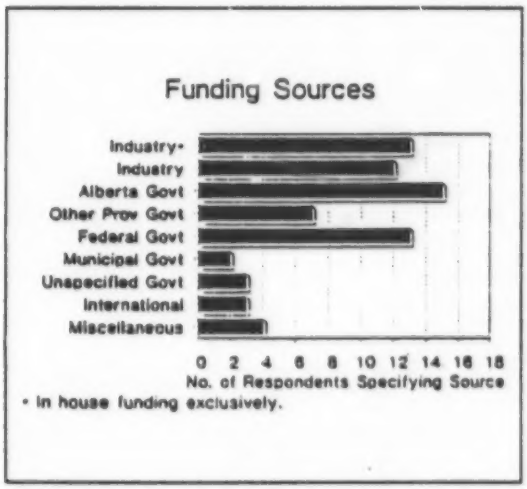


The respondents listed a wide range of activities (see Table 2) capabilities and interests which are grouped under the headings:

- atmospheric chemistry, meteorology and processes;
- effects on health, animals and the environment;
- integration of issues and information;
- technology and management strategies; and
- funding and management of science.

Note how many organizations are involved in information services and monitoring. Only the organizations which specifically stated that they fund and/or manage research have been listed under that category.

Respondents were not particularly forthcoming with respect to sources and levels of funding. From the information that was given, the adjacent chart has been derived which shows the number of respondents who specified the various categories of funding sources. A given respondent often cited more than one source of funding. In general, respondents did not specify the amount of funding that they receive from the various sources. It was therefore not possible to identify the major financial sponsors. Most respondents reported at least some funding from government sources. Forty-one percent (41%) of the respondents indicated that some of their results or activities may be confidential or proprietary.



Clean air issues are of at least peripheral interest to many organizations and therefore many organizations fund research on these issues. The magnitude of the number of organizations involved is illustrated in Table 3 which gives a breakdown by organization of the Alberta Government funds cited by the respondents as supporting their research and technology development activities. For many of these Alberta Government organizations, clean air is not the central focus of their mandate. The large number of organizations that have an interest in clean air issues and the fact that for many clean air is not the driving force for their existence makes coordination of activities difficult.

Respondents were also invited to comment (see Annex 2) on topics that, in their view, are relevant to clean air but were not addressed by the questionnaire. Fourteen of the 60 respondents suggested such topics. Three of the 14 suggested that indoor air quality as well as ambient air quality should be considered because Albertans spend so much time indoors (due to our climate). Two of the 14 wondered if health effects were being addressed adequately. Research and development incentives, financial support for research and development, the need for national research centres in the West, development of instrumentation, technology transfer and overseas application of Alberta technology were also mentioned.

TABLE 2:

ACTIVITIES, CAPABILITIES AND INTERESTS OF RESPONDENTS

TYPE	SPECIFIC	ORGANIZATION
Atmospheric Chemistry, Meteorology and Processes	monitoring of weather/climate	AA, A Environ, AFLW, ARC, WR, EC
	of air toxics	A Environ
	of air quality	ME, GWWT, ERCB, Esso, CHE, BCE, SEPS, A Environ, Syncrude, WR, ARC, EP
	of SO_2 emissions	Shell
	of stack gas emissions	SRC, A Environ, U of A, ARC, EP
	of cooling tower emissions	ICTI
	of site emissions	Suncor, CAC
	of turbulence	U of A
	of glaciers, ice sheets	EMR
	of agrometeorological parameters	AC
	sampling and analysis of air toxics	A Environ, EC
	of air pollutants	A Environ, EMR, U of A
	of coal emissions	ARC
	of vehicle emissions	CHE
	of air	A Environ, ARC
	of flue gas	A Environ
	of greenhouse gases	A Environ
	studies of interactions between NO_x, VO_c, O_3	Esso, Shell
	of herbicides/pesticides	SRC, AC
	of smog/ozone production	NRC, EP
	of precipitation physics	ARC, EC
	of global warming	UBC
	of sources and sinks of greenhouse gases	AC
	of greenhouse gas exchanges between surface and atmosphere	AC
	of regional fluxes of CO_2 and H_2O vapour	AC
	of heat exchanges between surface and atmosphere	AC
	of atmospheric transfer of agrochemicals	AC
	of urban air pollution	UBC
	of mesometeorology	UBC
	of climate variability	UBC, ARC
	of gas treatment	Esso
	of indoor air quality	U of C
	emissions inventories	Esso, Shell, CHE, ERCB, CPA, A Energy
	instrumentation/monitoring system	SRC, WR, ARC, UBC, MD
	isotope geochemistry	U OF V
	remote sensing	UBC, ARC

TABLE 2:

ACTIVITIES, CAPABILITIES AND INTERESTS OF RESPONDENTS

TYPE	SPECIFIC	ORGANIZATION
Effects on Health, Animals and the Environment	environmental impact assessment	BCE, Suncor, A Environ, EC
	effects of global warming	U of G, SRC, SEN, PFRA, ARC
	of air quality on forest growth	AFLW
	of global change on health	U of A
	implications of alternative energy technologies on health	U of A
	soils, vegetation sampling/monitoring	CME, AFLW
	bio-monitoring	Suncor
	acid deposition research/dry and wet	U of A, ARC, EP, ERCB, A Environ, PFRA
	hydrogen sulfide toxicity research and toxicity research in general	ERCB, U of A, A Environ
	soil chemistry	A Environ
	dose - response evaluation	A Environ
	forest ecology	AFLW
	occupational health studies	U of A
	community health assessment	U of A
	clinical toxicology	U of A
	epidemiological studies	U of A
	severe weather research	U of A, ARC
	hydrometeorological impact studies	EC
Integration of Issues and Information	Information Services	CC, CCPA, AFLW, U of A, CPA, AA, ARC, FEESA, SEPAC, EMR, EC, AOSTRA
	Integrated Data Bases	A Environ
	Information Acquisition/Processing Systems	MD, U of C
	modelling of air quality/pollutants	CME, GWAT, ERCB, U of A, EP
	of dispersion	BCE, IPAC, Esso, UR, ARC
	of tropospheric reactions	NRC
	of point source diffusion	A Environ
	of deposition	A Environ, ARC
	of turbulence	U of A
	of climate	U of A, ARC, UBC, EC
	of climate change	U of A, ARC, UBC, EC
	of climate variability	U of A, ARC, UBC, EC
	of effects	ARC
	of urban atmospheres	ARC
	of mesometeorological processes	UBC
	of acquiver/reservoir optimization	ARC
	of geochemical processes	ARC
	of efficiency	ARC
	international global change program	U of V, EC
	international energy agency activities	EMR
	climate studies	EMR
	meteorological statistics	ARC
	geographic information systems	ARC
	interdisciplinary environmental research	ARC
	international liaison	EC

TABLE 2:

ACTIVITIES, CAPABILITIES AND INTERESTS OF RESPONDENTS

TYPE	SPECIFIC		ORGANIZATION
Technology and Management Strategies	technologies	- agglomeration	ARC
		- clean fuel	ARC, ENR
		- clean combustion	ARC, UCLA, A Energy, ENR
		- clean coal	A Energy, CERI, NRC, SEN, CAC, ARC
		- pollution control	A Environ
		- hydrocarbon	ENR
		- acid rain control	EC
		- greenhouse gas control	EC
		- high efficiency power generation	EC
		- fuel upgrading	ARC, AOSTRA
	strategies	- radon	SRC
		- clean air	SEN
		- adaptation	ARC, U of G, EC
	evaluation of global warming science		Esso, EP
	emission trading		Shell, ERCB
	issue prioritization		Shell
	regulation development		CME, A Environ, ec
	policy reserach, development, statement		U of G, EC, CERI, IPAC, CMA, U of A, CPA
	evaluation of research technology		CPA
	air management planning		BCE, ME, A Environ
	demand side management		CERI, EP
	strategy development		CCPA
	engineering	- environmental	U of A
		- design for plants	ICTI, ARC, EP
		- design of energy efficient buildings	U of C
		- agriculture	AA
	hydrogen	- production, liquidfaction systems	ARC, Shell, AOSTRA, ENR, A Energy
		- non hydrocarbon sources of	AOSTRA, A Energy
	effluent control		ARC
	emission control/reduction		Syncrude, ARC, AOSTRA, EP, CO, BCE, UCLD, ERCB, A Environ, ENR
	CO_2 capture/disposal/utilization/ reduction		Suncor, Esso, Shell, CO, SEN, ERCB, ARC, AOSTRA, A Energy
	SO_2 removal/capture/recovery		Suncor, AOSTRA
	sulphur recovery		UCLD, ERCB
	enhanced oil recovery		UCLD, ARC
	alternative fuels		BCE, CERI, NRC
	fuel substitution		ARC
	cogeneration		ENR, EP
	renewable energy		A Energy
	combustion of coal/oil blends		NRC
	combustion assessment/monitoring		ARC, AOSTRA, ENR
	fluid bed combustion		ENR
	coal gasification		UCLD, A Energy
	wet scrubber system		NRC
	incinerator flue gas scrubbing		NRC
	district energy studies		EP
	biofuel process development		ARC, ENR
	recycling/waste disposal		U of A
	daylighting systems		U of C
	reforestation/silviculture		AFLU
	development of agricultural practices for reduced fossil fuel utilization		AC
	risk assessment		U of A
	clinical management		U of A
	odour complaint response		Suncor
	sick building diagnostics		SRC

TABLE 2:

ACTIVITIES, CAPABILITIES AND INTERESTS OF RESPONDENTS

TYPE	SPECIFIC	ORGANIZATION
Funding and Management of Science	ability to fund research	AA, A Energy, ARC
	ability to fund industry research	IPAC, EMR
	ability to organize funding	ACR
	co-funder of research	EP, ARC
	planning, management and financial support for research, technology development and demonstration	AOSTRA, ARC
	identification of research needs	EC
	coordination and promotion of research initiatives	EC, ARC
	management of R & D projects	EC, ARC

TABLE 4:

SOME COORDINATING COMMITTEES CITED BY RESPONDENTS

Acid Deposition Program Committee
Alberta Agrometeorology Committee
Alberta Oil Sands Technology and Research Authority/Industry/University Project Selection Committee
Alberta Oil Sands Technology and Research Authority/Alberta Research Council Policy and Program Committee
Alberta/Ontario Coal Association
Alberta Petroleum Industry and Government Environmental Committee
Association of Provincial Research Organizations
Canadian Construction Research Board
Canadian Contingent for the World Energy Congress
Canadian Electrical Association Technical Committees
Canada-Japan Coal and R & D Cooperation Agreement
Canadian Meteorological and Oceanographic Society Scientific Committee
Canadian Petroleum Association Advisory Committee
Carbon Dioxide and Brines Working Group
Federal/Provincial Agriculture Committee on Environmental Sustainability
Federal/Provincial Round Table on Energy and Economy
Great Lakes Water Quality Agreement
Hydrogen Industry Council
International Energy Association International Committee on R & D
IDAC Federal Interdepartmental Review Committee
Independent Petroleum Association of Canada Coal R & D Committee
IPACE Federal/Provincial Advisory Committee
MMACC Industry Advisory Committee to CANMET
Monitoring Coordinating Committee on Long Range Transport of Air Pollutants
Weather Advisory Committee

COORDINATION OF SCIENCE AND TECHNOLOGY RELATED TO CLEAN AIR ISSUES

A number of comments volunteered by respondents from industry indicated a desire on the part of industry to:

- be more involved in government initiatives;
- be more aware of what government is doing in research and development;
- have research and development activities coordinated so as to avoid duplication;
- possibly have government take the lead to facilitate and coordinate research and technology development and to provide seed money.

On the other hand, two University professors commented that there are dangers inherent in attempting to coordinate research and that duplication in research is not a problem because:

- one learns by doing;
- some duplication is necessary to validate results;
- no two people will do exactly the same thing in research; and
- professors have the right to choose whatever research they wish to do.

The coordination of research to be funded by Canada's Green Plan for a healthy environment is under intense discussion within the federal government. So much so, that the effort to prioritize and coordinate research and technology development is beginning to be carried over into non-Green Plan funded activities as well. As part of this effort, new committees are being developed and the mandate and terms of reference of some existing committees are being expanded. It is difficult to obtain up-to-date information on this topic. In Alberta, the coordination of science and technology is also being scrutinized.

In any case, some existing coordination mechanisms that were specified by the respondents are described and summarized below. This is not a comprehensive listing, rather, the councils, boards and committees listed below should be considered to be examples of the kind of mechanisms that exist.

Some Existing Coordination Mechanisms

1) Panel on Energy Research and Development of the Government of Canada (PERD)

The Federal Energy R & D Program is an interdepartmental program coordinated by the **Panel on Energy Research and Development (PERD)**, on which participating departments and agencies are represented. Each has expertise and capability through its own R & D program, which enables it to participate effectively in related energy R & D projects sponsored by PERD. These projects are performed in cooperation with the provinces, private sector, academia and other nations as appropriate. The overall objective of the program is to provide the science and technology for a diversified, economically and environmentally sustainable energy economy. **PERD has a central policy and planning role which requires it to identify new opportunities, terminate**

completed programs and assess strategy and priorities in the light of changing energy policy objectives and changes in the national and international situation. PERD is responsible for reviewing and coordinating the program and monitoring its products. **PERD has an absolute requirement that each part of the program has an external review of managerial, scientific, technical efficiency and utility.** This is managed through a system of interdepartmental committees which incorporate private sector recommendations, and the Office of Energy Research and Development (OERD) which acts as the Secretariat to the Panel and coordinates the distribution of panel funds to the R & D program. Within a continuous five-year planning framework, the panel recommends a package of work, with appropriate resource allocation. Upon approval by the Treasury Board, resources are placed in the budgets of the participating departments to manage the delivery of their parts of the program. About 70 per cent of the funds are contracted out, thereby promoting technology transfer.

2) Canadian Reference Group, Energy Technology Systems Analysis Project (ETSAP)

In 1976, the International Energy Agency initiated an Energy Technology Systems Analysis Project to analyze technical energy options at regional, provincial or national scales. Fifteen member countries, including Canada, and the Commission of European Communities participate in this project. **The current phase of the project aims to assess the optimal, least-cost technical means of achieving various environmental goals, such as reduction of acid rain and greenhouse gases.** Canada's participation is to provide a common Canadian and global basis for choosing cost effective methods to reduce the emissions of acid rain and greenhouse gases from energy systems at minimum costs. Currently, a Canadian reference group is being set up by Environment Canada which is to be composed of stakeholders from the federal and provincial governments, industrial and academic sectors. These **stakeholders will propose, examine and compare the environmental and economic impact of various policy options and, hopefully, will develop a national consensus.**

3) Canadian Climate Program Board (CCPB)

The Board makes recommendations on climate program priorities and to provide the liaison and guidance necessary for the successful operation of the program on a national and international basis. The Board advises on the actions required to introduce climate and climate-related information into government policy and provides the understanding needed for the process. The Board is an advisory committee. Committees of the Board are the Data and Applications Committee, the Socio-economic Impacts Committee and the Research Committee.

The Canadian Climate Program Research Committee is to provide scientific guidance and research objectives on Canadian participation in the World Climate Research Program and to advise and inform concerned agencies on Canadian participation and on the adequacy of overall funding.

The Socio-Economic Impacts Committee makes recommendations to the

Canadian Climate Program Board on research priorities concerning impact studies for climate change.

The Data and Applications Committee of the Canadian Climate Program Board makes recommendations to the Board on the needs of various climate data users in Canada and on the ways their needs can be met. It also advises on the potential applications for climate data and the accessibility and publication of Canadian climate information and data. A number of provincial climate advisory committees, **including the Alberta Climate Advisory Committee**, report to the Data and Applications Committee of the Canadian Climate Program Board.

The purpose of the Alberta Climate Advisory Committee is to identify climatologically related needs and concerns in the Province of Alberta, and to recommend appropriate measures to satisfy these needs.

4) The Canadian Council of Ministers of the Environment (CCME).

The Canadian Council of Ministers of the Environment is the major intergovernmental forum in Canada for discussion and joint action on environmental issues of national, international and global concern. CCME has a long history of establishing national environmental standards, codes of practice, and so on. Environment ministers from each of the 10 provinces, the federal government, and the two territories participate in regular CCME meetings at least twice a year. They meet to exchange information, make decisions, and provide direction to government officials for work to be carried out under the auspices of CCME. CCME is a permanent organization that consists of ministers representing each of the 13 governments, a full-time secretariat, and a permanent organizational structure. Meetings of the Council of Ministers are the core of the organization. Between meetings of the Council of Ministers, the work of CCME is carried out by a National Committee of Deputy Ministers, a Management Committee (which consists of five Deputy Ministers) and the secretariat. **Two permanent steering committees, Environmental Protection and Strategic Planning, coordinate all CCME projects by assigning them to specific ad-hoc intergovernmental task groups.** In the category of atmospheric issues, **the Environmental Protection Committee is analyzing possible approaches to integrating activities related to ozone depletion, acid rain, climate change and other aspects of air quality.**

5) CEPA Federal/Provincial Advisory Committee

The need for a continuing federal-provincial dialogue with respect to the Canadian Environmental Protection Act (CEPA) is recognized through the existance of the CEPA Federal/Provincial Advisory Committee. This Committee comprises the Federal/Provincial Advisory Sub-Committee on Air Quality. The purpose and objectives of the Committee take account of the division of jurisdictional power between the federal and provincial levels of government in air pollution control, which has traditionally required a unique and continuing level of federal-provincial consultation and cooperation.

The Committee aims to achieve uniformity of air quality management on a national scale by assisting the federal and provincial governments to maintain an acceptable level of air quality in all regions of Canada.

6) The Federal/Provincial Accords Committee on Environmental Sustainability and the Green Plan.

Federal/provincial accord committees were set up in 1987 to deal with the issues of soil and water conservation. As a result of the Agriculture Policy Review, it was decided that the accord committees' mandate and membership be broadened to reflect the issues identified in the Federal/Provincial Agriculture Report on Environmental Sustainability. Details regarding structure and operation are under development.

7) Western Accord on Environmental Cooperation

The Western and Northern Canada Acid Deposition/Long Range Transport of Air Pollutants Program represents a commitment to cooperative action to:

- maintain a high standard of air quality throughout Western and Northern Canada;
- protect sensitive areas;
- work towards harmonized air quality standards;
- develop an integrated air quality monitoring network;
- freely exchange data; and
- cooperate on scientific activities

on the part of the governments of British Columbia, Alberta, Saskatchewan, Manitoba, the Northwest Territories and Canada. **To plan a program of environmental studies, and to coordinate resources is the primary responsibility of the Technical Committee for the Program.**

In Regina, on 20 February 1991, environment, energy and resources ministers from the Western Provinces and Territories endorsed a framework for regional cooperation on environmental issues. This accord supersedes the Western and Northern Canada Acid Deposition/Long Range Transport of Air Pollutants Program. **The Western Accord on Environmental Cooperation includes developing and sharing environmental research and information and establishing a priority list of issues requiring immediate action.**

8) Technology and Research Advisory Committee (TRAC)

This committee plays a lead role within the Alberta government in coordinating the intra-governmental technical review and technical recommendations for major, technology-oriented proposals to Cabinet. It reports to the Minister of Technology, Research and Telecommunications.

9) Natural Resources Coordinating Council (NRCC)

The Natural Resources Coordinating Council of the Alberta government was created under the Department of the Environment Act. It can review any policies, programs, services, or administrative procedures of departments of the government of Alberta or of government agencies in matters pertaining to the environment 3). It reports to the Minister of the Environment. It does not generally concern itself with research priorities. The Natural Resources Advisory Committee (NRAC) reports to the Natural Resources Coordinating Council. **The Natural Resources Advisory Committee was established to improve inter-departmental cooperation and coordination in matters relating to environment and development, management and conservation of land and natural resources.** The Committee is consultative and advisory, serving both as a forum for information exchange and a vehicle for policy and program coordination. The members are senior government executives usually Assistant Deputy Ministers and Executive Directors. The Energy Resources Conservation Board (ERCB) and the Alberta Research Council (ARC) are also represented on the Committee. Both co-chairmen of the Clean Air Strategy Advisory Group are members of NRAC.

10) Program Committees

Respondents specified a myriad of program/steering/management/technical committees (see Table 4 for some of them) as coordinating mechanisms. Some appear to be effective coordinating mechanisms for particular programs or special interests, others appear to be little more than information exchange forums. One committee that is considered to be fairly effective at prioritizing research needs is the Alberta Oil Sands Technology and Research Authority (AOSTRA)/Alberta Research Council (ARC) Policy and Program Committee.

The AOSTRA/ARC/Industry Research Program in Advanced In Situ Oil Sands Recovery provides mission-oriented, multi-disciplinary research aimed at developing advanced processes for the cost-effective recovery of bitumen and heavy oil. The program provides participating companies with direct access to research results, commercial use rights of project technology and the opportunity to play a major role in developing the research program. **Long-range planning for the program is the responsibility of the Policy and Program Committee which has a majority of industry members and a chairperson from industry. The technical progress of the program is monitored by a technical committee.** Interactions at the working level are provided by project subcommittees.

Other Existing Coordination Mechanisms

Respondents specified a variety of other mechanisms that coordinate their activities with those of other organizations. Some are described below.

Contracts

A number of respondents conduct research and technology development activities on a fee-for-service basis. Their activities are therefore coordinated with those of their clients.

Joint Projects

More and more research and technology development projects are supported by a consortium of organizations and the projects are carried out by a team whose members belong to different organizations. Such partnerships inevitably lead to some coordination of activities within the participating organizations.

Memorandum of Understanding

Often organizations which share some common interest announce that they intend to cooperate by signing a memorandum of understanding (MOU). Such MOU's are common, for instance the Alberta Research Council has some 28 active ones. MOU's generally lead to an exchange of information among the organizations involved and to a few joint projects.

Professional/Industrial Associations/Networks

Many professional and industrial associations and networks exist to facilitate the exchange of information and networking. Most appear to play only a minor role in actually prioritizing and coordinating activities.

Board of Directors

A number of respondents suggested that coordination of their activities is provided through their board of directors.

Government Regulations

To a certain extent, research and technology development activities with respect to environmental issues, particularly within industry, are prompted by government regulations and agreements.

Staff Exchange Programs

A number of respondents cited staff exchange programs as a coordination mechanism. Staff exchanges certainly facilitate information exchange and networking.

Information Exchange Mechanisms

Respondents specified a variety of mechanisms that they utilize for exchanging information (Table 5).

Discussion

The report of the National Advisory Board on Science and Technology, entitled

"Revitalizing Science and Technology in the Government of Canada" (the Lortie report), presented to the Prime Minister of Canada in November 1990, lists as key elements to the successful performance of research

- a clear mission;
- a revenue dependency funding relationship (i.e. he who pays the piper calls the tune);
- an evaluation regime; and
- an appropriate management/organizational structure.

In assessing the adequacy of existing coordination mechanisms for coordinating science and technology activities required to realize the Clean Air Strategy for Alberta, it is therefore necessary to consider:

- the mission/mandate/purpose/objectives of the Clean Air Strategy for Alberta and that of the various existing coordination mechanisms;
- the stakeholders who need science and technology results from the Clean Air Strategy for Alberta and who should therefore fund the required research and development activities and the stakeholders who fund the activities coordinated by existing coordination mechanisms; and
- the evaluation and management/organizational structures required by the Clean Air Strategy for Alberta and those in place for the existing coordination mechanisms.

In perusing the listed existing coordination mechanisms it is immediately apparent that most of the broad scope mechanisms that could cover a wide variety of research interests are advisory in nature and, in any case, do not concern themselves primarily with identifying and prioritizing research needs and coordinating and evaluating research. Of the boards, councils, committees listed, only PERD, the Technical Committee of the Western and Northern Canada Acid Deposition/Long Range Transport of Air Pollutants Program and the AOSTRA/ARC Policy and Program Committee seem to focus on identifying and prioritizing research needs, coordinating and evaluating research programs.

Staff from Energy Mines and Resources Canada and from Environment Canada expressed the opinion that the Panel on Energy Research and Development (PERD) is reasonably effective in prioritizing and coordinating research related to energy development funded by the federal government. However, the Clean Air Strategy for Alberta is of vital interest to the government of Alberta and to industry within Alberta as well as to the federal government. Thus any research and development activities required by the Strategy should probably be supported financially by all three levels: the provincial government, the federal government and industry.

The Technical Committee of the Western and Northern Canada Acid Deposition/Long Range Transport of Air Pollutants Program is being disbanded because the program is being replaced by the Western Accord on Environmental Cooperation. Perhaps something similar to the Technical Committee will be put in place for the Accord.

The AOSTRA/ARC/Industry Research Program covers only advanced in situ oil sands recovery research.

CONCLUDING REMARKS

A reviewer of this report (from industry) commented that "there seems to be a plethora of committees providing advice to funding agencies whose task it is to allocate resources where effort is needed" but a key missing ingredient seems to be strategic direction. One of the questionnaire respondents (also from industry) suggested that "government has a valuable role to play in facilitating joint research and development studies by bringing together participants, coordination of activities and providing seed money". Perhaps by bringing together the participants (or stakeholders) periodically, strategic directions can be established which can then be implemented through facilitation and cooperation among the funding agencies and researchers.

TABLE 5:

INFORMATION EXCHANGE MECHANISMS

annual business plans/meetings/national statements/reports
brochures/fact sheets/pamphlets
codes of practice
commercial demonstrations
company reports
decision reports
electronic mail
exchange visits/staff exchange programs
formal submissions to government
general bulletins/interim directives
guides/guidelines
magazines/newspapers
media interviews
membership in professional/industry/special interest associations
memoranda of understanding
newsletters
participation in committees/task forces
patents and licences
personal contacts
presentations at meetings/technical meetings
press releases
public education programs
publication in scientific/technical journals
required performance reporting
research/technical reports
science fairs
seminars
state of the environment reports
technology exchange agreements
technology sales meetings
teaching
UNITAR conferences
working papers
workshops/symposia

Clean Air Strategy for Alberta

ENERGY AND ENVIRONMENT EDUCATION INITIATIVES- AN INVENTORY & OVERVIEW

Prepared by:
Alberta Department of Energy
Environmental Affairs Branch

June 1991

ENERGY AND ENVIRONMENT EDUCATION INITIATIVES- AN INVENTORY & OVERVIEW

Objectives:

- To identify education initiatives which address or could address issues related to energy and the environment under CASA.

- To present the findings in a form which will provided reviewers with a functional basis for interpretation and decision making.

Methodology

- Using data obtained by The Pembina Institute in their recent comprehensive survey of virtually all sources of environmental educational materials, identify any programs providing education initiatives on global warming, acid deposition or urban smog.

- Classify by target audience the materials included above.

Discussion

The ultimate challenge inherent in developing a program such as CASA is in creating a new forum of understanding which is different from that currently understood and generally accepted by the majority of the population. The magnitude of the challenge is affected by a number of factors. Some of these include:

a) the need for the lifestyle change associated with environmental surety is most often perceived as a reduction or loss in either current or expected standard of living;

b) a significant portion of our society consider environment issues to be "someone else's problem";

c) the large number of other social issues demanding attention (eg. drug & alcohol addiction, abortion, health care, the Constitution, taxation and other pressures around economic recession and job loss);

d) the lack of a unified understanding around the magnitude of various issues (and the public "airing" of often contradictory findings and opinions by considered experts); and

e) the inability of individuals to appreciate the significance of how their actions translate into making a difference.

In the face of what might appear as a monumental task, there is both the hope and commitment that with effective leadership and direction we will be able to create the understanding and support required to ensure the health and livelihood of future generations.

In preparing an inventory of materials which are already in place, it became clear that much remains to be done to integrate the availability of content (hard data and information) with the processes of learning (both formal and informal). While there has been progress on the educational front, much of the current availability of material relating to environmental considerations could be classified as informational. Significant work remains to provide materials for use in educational applications.

There have been suggestions of the need to review recommended materials for use and effectiveness. In this regard, there is definite need to establish criteria upon which to perform a review. Of necessity, this criteria should consider user requirements, behavioral effectiveness, as well as audience needs.

- Classification by user - The major classifications are fairly obvious and well defined (eg. K-12, post-secondary, extension). However, there are some specific sub-categories within each of the major classifications which may require consideration. Factors include various socio-economic classes as well as location (urban vs rural).

- Consideration of needs - These include not only the implications for the classifications indicated above which consider the "learners", but also those of the professionals and leaders (eg. teachers and others who are pro-active). It would appear that much remains to be done in this area to ensure active and effective use of both available and developed materials.

Observations regarding the attached inventory:

1) While there is a substantial amount of materials available as education initiatives relating to energy and the environment, the abundance of that which is currently available is from the United States.

2) While there is evidence of meaningful progress in the development of material for use by teachers, the shortfalls that have been reported relating to the need to use imported materials include:
   - examples which often do not relate to the Alberta situation;
   - factual data which is non metric; and
   - no specific integration with Alberta curriculum.

3) Perhaps as a sign of the early stages of awareness and development, it appears that much remains to be done to accommodate the integration of environmental considerations within established curriculum. For example: in chemistry experiments; in maths problems; and in the examination of social studies.

INVENTORY OF ENERGY AND ENVIRONMENT EDUCATION INITIATIVES

SECTION A: **Materials in this section have been reviewed first hand and are considered to be directly related to relevant issues:**

TITLE	PUBLISHER	LOCATION	GRADES	COMMENT
Acid Rain	Lawrence Hall of Science	California	7 - 9	well organized, easy to teach
Elementary Acid Rain Kit/Curriculum	Acid Rain Foundation Inc.	North Carolina	4 - 8	$20 U.S., excellent activities
The Acid Rain Reader	Acid Rain Foundation Inc.	North Carolina	4 - 8	18pp, $6 U.S., excellent resource
Acid Rain Curriculum	Acid Rain Foundation Inc.	North Carolina	6 - 12	$60 U.s./set; $20 U.S./ Section very comprehensive
Acid Rain: Science Projects	Acid Rain Foundation Inc.	North Carolina	6 - 12	22pp, $10. U.S. interesting activities some shortage of information
Air Pollutants: Effects on Trees	U.S. Forest Service	North Carolina	6 - 12	150 pp/$15 U.S. 2 volumes (Trees & the Forest Environment; trees and air Pollution) well laid out and easy to follow.
Global Warming and the Greenhouse Effect	Lawrence Hall of Science	California	7 - 9	Useful and well thought out
Our Only Earth Series	Zephyr Press	Arizona	7 - 12	6 books, $90 U.S., an integrated curriculum

SECTION B: **Materials in this section have been reviewed first-hand and contain portions which directly relate to relevant issues.**

TITLE	PUBLISHER	LOCATION	GRADES	COMMENT
Our Threatened Planet	R.V. Taylor	Ontario	7 - 12	56pp, $9, considered an excellent resource
Destination Conservation: Protection Manual	E.R.C.	Edmonton		
Earth Day 1990 Lesson Plan & Home Survey	Earth Day 1990	California	7 - 12	40pp, good fact sheets but too broad in scope
The Energy Literacy Series	SEEDS/SRA (Canada)	Toronto	K - 6	Somewhat general, but has 2 chapters on air quality
Earth Trek: Explore Your Environment	U.S. Environmental Protection Agency	Washington		
For Earth's Sake	Zero Population Growth	U.S.	7 - 9	$28 U.S., a useful resource linking population growth to environmental demands
Global 2000 Countdown Kit	Zero Population Growth		7 - 12	$22 U.S., a projection of current trends, a good learning tool
Global Science: Energy, Resources, Environment	Kendall/Hunt	Iowa		$77 U.S., 3 books
Last Forecast: Educators Care Package		U.S.		Kit
One World	Reidmore Bookstore Inc.	Edmonton	7 - 12	147pp, $29, considered a very good resource/text for in a Sr. High School
Somebody Should Do Something About This! A Teachers Resource Book	Alberta Energy	Edmonton	K - 12	152pp on energy and the environment, considered a very useful resource

SECTION C: **Based on promotional literature and other sources, materials in this section have been identified as being directly related to relevant issues.**

TITLE	PUBLISHER	LOCATION	GRADES	COMMENT
Acid Precipitation Awareness & Activity Package	New Jersey Dept. of Environment Protection	New Jersey		
Acid Rain Deposition Kit	Federation of Ontario Naturalists	Ontario		
Acid Rain Poster	Canadian Nature Federation	Ontario		
Acid Rain Primer	Pollution Probe Foundation	Toronto		
Acid Rain Software Package	Diversified Education Enterprises	Indiana		
Acid Rain Visual Learning Package	Acid Rain Foundation			

SECTION D: **Materials in this section have not been reviewed first-hand, and direct reference sources are minimal.**

TITLE	PUBLISHER	LOCATION	GRADES	COMMENT
Acid Rain Software for Young People	PUCE	Quebec		
Acid Rain: What Is It and How Is It Measured	Global Tomorrow Coaltion			
Childrens Environmental Games Outreach Program	Public Focus	Toronto		
Acid Rain	Social Studies School Service	California		Chosen because S.S. School Service produced curriculum
Acid Rain (Chart)	Social Studies School Service	California		Chosen because S.S. School Service produced curriculum
Greenhouse Effect	Social Studies School Service	California		Chosen because S.S. School Service produced curriculum
Greenhouse Effect (Chart)	Social Studies School Service	California		Chosen because S.S. School Service produced curriculum
Climate Crisis: Greenhouse Effect and the Ozone Layer	Social Studies School Service	California		Chosen because S.S. School Service produced curriculum
Environmental Education Actitives Manual	William Stapp	Michigan		
Greenhouse Effect	Social Studies School Service	California		Chosen because S.S. School Service produced curriculum
Greenhouse Effect (Chart)	Social Studies School Service	California		